

PART-A: RESEARCH

Pakistan Tobacco Board is conducting research programs at its different Research Stations in all Provinces of Pakistan and also at growers' fields with a view to introduce high yielding, disease resistant and good quality tobacco varieties through improved agro-techniques with the aim to minimize cost of production.

Following is the resume of research results obtained from Research Stations:

I. TOBACCO RESEARCH STATION (TRS), MARDAN

A. CHEMISTRY SECTION

TITLE NO. 1: EVALUATION OF VARIOUS LEVELS OF NPK FERTILIZER ON FLUE CURED VIRGINIA TOBACCO FOR HIGH YIELD AND GRADE INDEX

Introduction

Tobacco belongs to family Solanaccae and genus Nicotiana. The widely cultivated species of Nicotiana are (*Nicotianatabacum* L. and *Nicotianarustica* L.). All over the world these species are cultivated as cash crop. The quality and yield of Flue-Cured Virginia tobacco (FCV) depends upon the soil texture, fertilization, depth of plough and nitrogen content of soil. The soils vary widely in physico-chemical properties and nutrients profile which considerably influences the type, grade and quality of FCV tobacco. Higher sugar and lower nicotine are obtained by the application of 60 and 70kg Nitrogen/Hectare (Chari *et al.* 1994). Nitrogen increases the vegetative growth of plants. Soil rich in Phosphorus content gave the highest cured leaf yield and quality of tobacco, if 112 kg N+112 kg P₂O₅ +112 kg K₂O/ha are applied. Potassium (K) balances the sugar-nicotine ratio and increases the yield and quality of tobacco (Hardter and Yuhong, 2000).

Treatments/Codes	Ratio	Kg/ha
	NPK	NPK
T₀	12:12:18	60:60:90
T₁	15:12:18	75:60:90
T₂	17:12:18	85:60:90
T₃	12:15:18	60:75:90
T₄	12:17:18	60:85:90
T₅	12:15:20	60:75:100
T₆	12:17:20	60:85:100
T₇	15:17:22	75:85:110

Note:- Due to severe hailstorm crop has damaged and data could not collected.

TITLE NO. 2: TO CHECK EFFICACY OF DIFFERENT PESTICIDES AND THEIR RESIDUAL EFFECT ON TOBACCO CROP

Material and Methodology

The use of insecticides and pesticides has increased during the past 3-4 decades and tobacco stakeholders'/companies' also facing problem in export of tobacco due to residual effect of pesticides. Pesticide residue refers to the pesticides or their breakdown products that may remain on or in food after harvesting or storage. The maximum allowable levels of these residues are often stipulated by regulatory bodies in many countries. Each country adopts their agricultural policies and Maximum Residue Limits (MRL) and Acceptable Daily Intake (ADI).

- T₁:** Cypermethrin 10% EC
- T₂:** Lufenuron 5% EC
- T₃:** Emamectin Benzoate 1.9% EC
- T₄:** Pendimethalin 330% EC
- T₅:** Metolachlor 960% EC
- T₆:** Flumetralin 12.5% EC
- T₇:** Carbendazim 50% WP
- T₈:** Control

Note:- No data was obtained due to hail storm damaged all the crop of Tobacco Research Station, Mardan.

TITLE NO. 3: SURVEY OF TOBACCO GROWING AREAS FOR EVALUATION OF SOIL PHYSICO-CHEMICAL COMPOSITION IN KHYBER PAKHTUNKHWA

Soil fertility plays an important role on the productivity of any crop. Soil test-based fertilizer recommendation will help the farmers to optimize the resources and improve the productivity. Survey was conducted to collect soil samples from different tobacco cultivated areas and analyzed in Chemistry Section, Tobacco Research Station, Mardan for various parameters.

SUMMARY OF THE PREVIOUS WORK

Table No. 1: Survey of Tobacco Growing Areas for Evaluation of Soil Physico-chemical Composition in Khyber Pakhtunkhwa year 2018-19:

District	Area	Ph	Electrical Conductivity (dSm ⁻¹)	Organic Matter %	Nitrogen %	Available Phosphorus P ₂ O ₅ ppm	Available Potash K ₂ O ppm	Texture
Mardan	<i>Shergrh</i>	7.6-8.2	0.31-0.53	0.27-0.61	0.04-0.10	5.40-12.48	58.00-120.00	Silt/silt Loam
	<i>TakhtBhai</i>	7.7-8.3	0.35-0.62	0.17-0.72	0.03-0.12	6.32-13.00	50.00-105.00	Silt/silt Loam
	<i>Khan garhi</i>	7.9-8.3	0.41-0.56	0.20-0.56	0.03-0.09	6.00-12.46	52.00-85.00	Silt/silt Loam
Charsada	<i>Mandani</i>	7.6-8.3	0.34-0.64	0.37-0.78	0.06-0.12	7.53-12.50	45.00-135.00	Silt/silt Loam
	<i>Sardheri</i>	7.7-8.2	0.44-0.67	0.28-0.69	0.04-0.11	8.23-13.97	67.00-140.00	Silt/silt Loam
Swabi	<i>Yar Hussain</i>	7.7-8.4	0.31-0.71	0.17-0.73	0.03-0.12	5.12-11.23	42.00-76.00	Silt/silt Loam
	<i>Charbagh</i>	7.5-8.1	0.26-0.72	0.27-0.84	0.04-0.13	4.56-10.44	48.00-95.00	Silt/silt Loam
	<i>ChotaLahor</i>	7.8-8.2	0.15-0.54	0.40-0.92	0.06-0.15	5.62-11.73	50.00-115.00	Silt/silt Loam
Buner	<i>Chamla</i>	7.0-7.9	0.30-0.67	0.34-0.83	0.05-0.14	6.00-13.40	70.00-112.00	Loam/ Sandy Loam
Mansehra	<i>Baffa</i>	6.9-7.8	0.19-0.51	0.38-0.78	0.06-0.12	7.45-14.02	65.00-105.00	Loam/ Sandy Loam

Soil samples of remaining tobacco growing areas i.e Jamal Garhi, Swat, Buner (Swari), Sharifabad, Mansehra etc will be collected for analysis during 2021-22.

Table No. 2: Tobacco leaf analysis

Tobacco leaf samples (357) were chemically analyzed during the year 2020-21 and their results have been given to the concerned departments, companies and persons and also can be seen in average table given below:

S. No	Name	Total	R. Sugar %	Nicotine %	Moisture %
01.	Abrar Ullah Tobacco dealer, DodherDistt. Swabi	FCV 02	6.61-11.08	2.15-2.62	-
02.	Gul Rehman (Representative) Frontier Traders	FCV 03	11.95-12.69	2.39-2.46	-
03.	UsmanMemon (Asstt.Chemist/ADO) Dadu, Sindh.	Rustica 06	4.08-5.32	2.77-3.72	10.79-12.01
04.	UsmanMemon (Asstt.Chemist/ADO) Dadu, Sindh.	Rustica 08	3.19-4.84	2.94-3.45	10.59-11.03
05.	Adress Khan (ADO) Mandani, Charsada.	SCV 01	14.2	2.52	9.01
06.	Muavia Malik (ADO) Jampur, Sindh.	Rustica 07	3.53-4.42	2.96-3.59	-
07.	Zafar Iqbal, Royal Tobacco Company, Swabi.	FCV 01	10.55	2.89	-
08.	Souvenir Tobacco Company, Mardan.	FCV 04	9.31-12.83	2.14-2.74	-
09.	Jan Bahadar, Distt. Swabi.	FCV 02	10.14-12.88	2.74-2.85	-

10.	Maaz Khan, Falcon Tobacco Company Limited.	FCV 03	10.96-12.14	2.35-2.86	-
11.	Botany Section Tobacco Research Station, Mardan. Transplantation Dates Trial Drought Tolerance Trial Homozygous Lines Trial Exotic Hybrid Trial Rustica Varietal Trial No. 1 Rustica Varietal Trial No. 2 Topping Height Trial	FCV 24 FCV 30 FCV 30 FCV 24 Rustica 15 Rustica 15 Rustica 09	9.57-13.16 7.8-12 8.46-13.18 7.5-13 4.69-5.9 4.5-5.78 4.38-5.65	1.85-2.9 2.02-2.91 1.35-2.61 1.51-2.28 3.12-3.71 3.2-3.47 3.31-3.58	-
12.	Falcon Tobacco Company, Swabi.	FCV 01	10.96	2.67	-
13.	Souvenir Tobacco Company, Mardan.	Tobacco 08	7.9-10.37	2.52-2.97	-
14.	Pak Hills Tobacco, Swabi.	Tobacco 05	8.62-11.07	2.29-2.89	-
15.	Tariq Majeedano (ARO) TRSS, Mansehra. Agronomy Trial Hybrid Trial	FCV 159	7.5-14.56 7.79-15.85	2.22-2.98 2.07-2.99	-

Table No. 3: Soil & Water Analysis:

Soil, water and fertilizer (40) samples were physico-chemically analyzed during the year 2020-21 and also can be seen in average table given below;

S. No	Name/Area	Total	pH	EC (dSm ⁻¹)	O.M %	Class	%Nitrogen	Potash ppm
01.	Muhammad Sohaib, Parkho.	04	8.0-8.2	0.395-0.567	0.172-0.241	Silt loam	0.03-0.04	52-58
02.	Amin Khan, Jhanday.	01	8.5	0.719	0.897	Sandy loam	-	-
03.	Bakhtiar, Pirsaddo	01	8.2	0.7	0.345	Silt loam	0.005	-
04.	Farm Manager, TMF, Ambela, Buner.	08	7.6-8.2	0.316-1.221	0-0.104	Sandy loam	0-0.016	-
05.	Phillip Morris International, Swabi.	16	7.65-8.12	0.255-0.615	0.069-0.69	Sandy loam-silt loam	0.01-0.11	-
06.	Abdul Hafeez, Mohib Banda.	05	8.06-8.65	0.211-0.513	0.069-0.138	Silt loam	0.01-0.06	58-87
07.	Amad Ali, Lundkhar.	02	8.21-8.34	0.273-0.407	0.138-0.241	Silt loam	0.02-0.04	65-72
08.	Aman Safi, Safiabad.	02	8.12-8.3	0.317-0.388	0.172-0.207	Silt loam	0.03-0.09	61-65
09.	Mohammad Younas, Maday Baba.	01	7.9	2.01	0.93	Silt loam	0.15	-

Table No. 4: Mineral Analysis:

Soil samples (353Nos) were analyzed for mineral analysis/soil nutrients during 2020-21;

<u>S. No</u>	<u>Student Name</u>	<u>University/Institute</u>	<u>Total</u>	<u>Mineral</u>
01.	Miss. Hafza	Bacha Khan University Charsada.	25	Ca, Cd, Cr, Fe, K, Mg, Mn, Ni, Pb, Zn
02.	Miss. Muskan	Bacha Khan University Charsada.	30	Ca, Ni, Fe, K, Mg, Mn, Na, Zn
03.	Miss. GulRukh	Bacha Khan University Charsada.	17	Ca, Ni, Fe, K, Mg, Mn, Na, Zn
04.	Miss. Rabia	Bacha Khan University Charsada.	19	Ca, Ni, Fe, K, Mg, Mn, Na, Zn
05.	Miss. Wajeaha	Bacha Khan University Charsada.	35	Ca, Fe, Mg, Na, Ni, Zn
06.	Mr. NajmulSaqib	Bacha Khan University Charsada.	24	Cd, Cr, Cu, Fe, Mn, Ni, Pb, Zn
07.	Mr. Zafran	Bacha Khan University Charsada.	20	Cu, Cr, Fe, Mn, Ni, Pb
08.	Mr. Fahad	Bacha Khan University Charsada.	20	Zn, Cd, Cr, Cu, Fe, Ni, Pb
09.	Mr. Ilyas	Bacha Khan University Charsada.	24	Cd, Cu, Fe, Mn, Ni, Pb, Zn
10.	Mr. Tahir Ullah	Bacha Khan University Charsada.	34	Cu, Cr, Fe, Mn, Ni, Pb
11.	Mr. Sunil	Bacha Khan University Charsada.	48	Ni
12.	Mr. Abdullah	Agriculture University Peshawar.	57	Zn

B. PLANT BREEDING AND GENETICS SECTION

TITLE NO. 1: EVALUATION OF FCV HYBRID VARIETIES UNDER AGRO-CLIMATIC CONDITIONS OF MARDAN

Research Methodology

This trial was conducted as a joint venture with PTC for evaluation of six FCV exotic hybrids (RJR603, RJR602, RJR213, RJR217, RJR215, and RJR902) under Agro-climatic conditions of KP including plain and mountainous regions. The Breeding section at TRS Mardan has been assigned to check the performance of six alien genotypes in plain areas. For this purpose, an experiment laid out in Randomized Complete Block (RCB) design with three replications having plant to plant and row to row distance of 2ft and 3ft, respectively. The FCV conventional varieties Spt-G-28 and K-399 were used as check cultivars.

Agronomical Parameters:

Due to severe hailstorm crop was damaged and the breeding section was able to collect the data only for the following parameters (Table 1). From the available data, it can be seen that the maximum (24) number of leaves plant⁻¹ were recorded in hybrids RJR603 and RJR213, while the check cultivar K-399 produced the minimum (21) number of leaves plant⁻¹. The widest leaf area (957 cm²) was observed in FCV hybrid RJR213 while the narrowest leaf area (838 cm²) was recorded in FCV hybrid RJR603, comparatively.

Chemical Analysis:

Chemical analysis for the above trial was performed only from bottom leaves (1st Picking). From the available leaves samples, the highest (2.23) nicotine content recorded in FCV hybrid RJR213, while the lowest (1.65) nicotine content recorded in FCV commercial variety Spt-G-28 (Table 2). Whereas, the highest (12.6) reducing sugar % noted in FCV hybrid RJR217, while the lowest (8.0) noted in another FCV hybrid RJR603 (Table 2).

TITLE NO. 2: EVALUATION OF FCV ADVANCED LINES FOR ASSESSMENT OF THEIR PERFORMANCE AND GENERATION ADVANCEMENT

Material and method of experiment

The inter-varietal FCV crosses were made during 2010 with an aim for the development of disease and drought-resistant FCV varieties. Eight lines out of these crosses were subjected for generation advancement after screening. The last cropping year (2020-21) was F₁₁ of these advanced lines. The trial conducted in Randomized Complete Block (RCB) design with three replications having plant to plant and row to row distance of 2ft and 3ft, respectively. The FCV conventional variety K-399 was used as a check cultivar.

Agronomical Parameters

As mentioned above hailstorms completely damaged the crop and only parameters mentioned in table 3 were recorded. From the available parameters L6 and L7 beard more (22) number of leaves plant⁻¹, while low (18) number of leaves plant⁻¹ produced by L4. Maximum leaf area (838.2 cm²) recorded in FCV standard cultivar K-399, while minimum leaf area (709.8 cm²) measured in L5.

Chemical Analysis

Chemical analysis for this trial was also performed only from bottom leaves (1st picking). From the available leaves samples, the highest Nicotine content (2.56) estimated in L3 and L5, while

the lowest nicotine content (1.42) calculated in L2 (Table 4). Likewise, the highest reducing sugar % (12.8) noted in L2 while the lowest reducing sugar % (9.0) noted in L8 (Table 4).

TITLE NO. 3: ADAPTABILITY TRIAL OF BURLEY TYPE TOBACCO

This trial was laid out to check the adaptability of five burley genotypes in plain areas. The trial was laid out as in the above trials. However, no data was recorded for this trial as it was transplanted late and hence didn't cope with the hailstorm.

Note: It is important to mention here that yield was not calculated as foliage parameters including green weight plot⁻¹, green leaves Kg⁻¹, cured weight plot⁻¹, and cured leaves Kg⁻¹ were calculated only from bottom leaves while it should be the average data of three pickings. Also, no statistical analysis has been carried out due to incomplete data. This year these experiments will be repeated, and a comprehensive report will be provided after driving valid conclusions/results.

Table 1: Mean data of agronomical parameters from FCV hybrid Varietal Trial

S.No	Hybrids/varieties	Plant Height (cm)	leaves plant ⁻¹	Leaf area (cm ²)	Green weight plot ⁻¹ (Kg)	Green leaves (Kg)	Cured weight plot ⁻¹ (kg)	Cured leaves (Kg)	Yield Hectare ⁻¹ (kg)
1	RJR603	-	24	838.3	43.5	38	6.3	241	-
2	RJR602	-	22	870.4	36.5	31	5.3	162	-
3	RJR213	-	24	957.7	42.5	32	6.2	199	-
4	RJR217	-	22	916.4	41	28	6.0	167	-
5	RJR215	-	23	932.2	43.5	36	6.3	229	-
6	RJR902	-	22	878.8	39.5	31	5.5	164	-
7	Spt-G-28	-	22	907.7	37.5	32	5.5	189	-
8	K-399	-	21	917.7	38	32	5.8	181	-

***Data from only 1st picking (Bottom leaves)**

Table 2: Chemical analysis of 1st picking (Bottom leaves) from FCV hybrid varietal trial

S.No	Hybrids/varieties	Nic %	Reducing sugar content
1	RJR603	1.91	8.0
2	RJR602	2.07	10.8
3	RJR213	2.23	9.1
4	RJR217	2.07	12.6
5	RJR215	2.07	12.3
6	RJR902	2.01	8.6
7	Spt-G-28	1.58	10.2
8	K-399	1.65	9.2

Table 3: Evaluation of FCV advanced lines for assessment of their performance and generation advancement

S.No	Hybrids/varieties	Plant Height (cm)	Leaves plant ⁻¹	Leaf area (cm ²)	Green weight plot ⁻¹ (kg)	Green leaves Kg ⁻¹	Cured weight plot ⁻¹ (kg)	Cured leaves Kg ⁻¹	Yield Hectare ⁻¹ (Kg)
1	L1	-	21	741.2	47	34	4.5	151	-
2	L2	-	19	744.6	35	30	5.1	155	-
3	L3	-	20	796.9	46	31	5.3	161	-
4	L4	-	18	766.4	37	27	5.0	135	-
5	L5	-	20	709.8	29	26	6.3	158	-
6	L6	-	22	741.0	45	32	6.4	205	-
7	L7	-	22	746.1	46	29	6.6	194	-
8	L8	-	19	758.0	38	25	7.5	186	-
9	K-399	-	21	838.2	43	33	6.1	213	-

*Data from 1st picking (Bottom leaves)

Table 4: Chemical analysis of 1st picking (Bottom leaves) from evaluation of FCV advanced lines

S.No	Hybrids/varieties	Nic %	Reducing sugar content
1	L1	2.07	9.3
2	L2	1.42	12.8
3	L3	2.56	11.9
4	L4	1.91	11.6
5	L5	2.56	10.4
6	L5	1.91	12.2
7	L7	2.14	9.7
8	L8	2.05	9.0
9	K-399	1.75	12.5

C. RUSTICA TRIALS

Rustica (*N. rustica* L) tobacco is not only important cash crop for the farmers but also used for smoking, snuffing, cigarette blending, in berries and for the extraction of nicotine for preparation of herbal (natural) insecticides. It plays an important role to boost-up our economy and to alleviate the poverty because it is source of income, a great source of Cess for PTB, a good Source of Foreign exchange, and a great source of employment. So the quality and yield should be improved and to make these characteristics better, every year the researchers tried their level best by conducting

various research experiments. This year various experiments were conducted on Rustica tobacco with following detailed research data and description.

TITLE NO.1: EVALUATION OF DIFFERENT VARIETIES OF RUSTICA TOBACCO

Experimental Material

An experiment conducted to check the performance of Rustica varieties under agro-climatic conditions of Mardan during the year 2020-21.

- (I) This was the 2nd year of this trial. Plant material comprised of 05 Rustica varieties viz; Rustica-Swabi, Rustica-18, Rustica-Bubak, Rustica-9, Rustica-13. All the recommended agronomic practices were performed. Results revealed from mean values (Table 1& Table 2) are given as under:

Mean performance

Plant Height maximum plant height (**65 cm²**) noted in Rustica -18 while minimum plant height (59 cm) noted in Rustica-9.

Leaf area maximum leaf area (**664 cm²**) measured in Rustica 18 while minimum leaf area (584 cm²) measured in Rustica-Bubak.

Number of leaves plant⁻¹ maximum number of leaves plant⁻¹ (13) found in Rustica 13 while minimum numbers of leaves plant⁻¹ (12) found in Rustica Swabi.

Green weight plot⁻¹ (kg) maximum green weight plot⁻¹ (13.67 kg) recorded in Rustica 18 while minimum green weight plot⁻¹ (13.33 kg) recorded in Rustica -Bubak.

Green leaves kg⁻¹ maximum green leaves kg⁻¹ (27) (25) counted in Rustica-18, Rustica-Bubak & Rustica-18 respectively and minimum green leaves kg⁻¹ found in Rustica-9 (21). *Green leaves and green weight plot⁻¹ is yield determining parameters. Therefore varieties with maximum green leaves kg⁻¹ gave greater yield while minimum gave fewer yields.*

Cured weight plot⁻¹ maximum cured weight plot⁻¹ (2.33 kg) weighed in Rustica-Swabi while minimum cured weight plot⁻¹ (1.8 kg) weighed in Rustica-18.

Cured leaves kg⁻¹ maximum **cured leaves kg⁻¹** (201) counted in Rustica-18 while minimum cured leaves kg⁻¹ (154) counted in Rustica-Swabi.

Cured Yield Hectare⁻¹ maximum yield hectare⁻¹ (5595 kg) recorded in Rustica-Swabi while minimum yield hectare⁻¹ (4304 kg) recorded in Rustica-18.

Nicotine % maximum nicotine% (3.66 %) noted in Rustica-Swabi while minimum nicotine (3.64%) noted in Rustica-13.

Reducing Sugar content maximum reducing sugar (5.5%) recorded in Rustica-Bubak while minimum reducing sugar (5.2 %) recorded in Rustica-

Treat./var	Plant Height (cm)	Leaf Area (cm ²)	Leaves Plant ⁻¹	Green Weight Plot ⁻¹ (kg)	Green Leaves kg ⁻¹	Cured Weight Plot ⁻¹ (kg)	Cured Leaves kg ⁻¹	Yield hectare ⁻¹ (kg)
R-Swabi	60	604	12	15	23	2.33	154	5595
R-18	65	664	12	13.67	27	1.8	201	4304
R-Bubak	60	584	12	13.33	25	2.164	167	5185
R-9	59	638	12	15	21	1.89	190	4531
R-13	64	636	13	17	24	2.160	181	5183

Treatments	Nicotine (%)	Reducing Sugar (%)
Bubak	3.55	5.5
R9	3.31	5.2
R18	3.19	5.4
R13	3.64	5.3
Swabi	3.66	5.4

TITLE NO. 2: EVALUATION OF DIFFERENT VARIETIES OF RUSTICA TOBACCO

This was the 2nd year of trial. Plant material comprised of 05 Rustica varieties viz; Rustica Rasoolabad, Rustica Hazro, Rustica 19, Rustica Jampur and Rustica-14. All the recommended agronomic practices were performed. Results revealed from mean values (Table 3 & Table 4) are given as under:

Plant height (cm) maximum plant height (65 cm) in Rustica-18 followed by Rustica-13 while minimum plant height (59 cm) observed in Rustica-9

Leaf area (cm²) maximum leaf area (607 cm²) recorded in Rustica Hazro while minimum leaf area (597 cm²) recorded in Rustica-Jampur.

Number of leaves plant⁻¹ maximum numbers of leaves plant⁻¹ (12) found in rustica Hazro & Rustica 14 (11) while minimum numbers of leaves plant⁻¹ (9) in Rustica-Jampur while rest of the varieties were topped at 10 leaves.

Green weight plot⁻¹ (kg) maximum green weight plot⁻¹ (13 kg) observed in Rustica-19 while minimum green weight plot⁻¹ (9.4 kg) observed in Rustica-Hazro.

Green leaves kg⁻¹ maximum green leaves kg⁻¹ (30) recorded in Rustica-Hazro followed by Rustica-14 with 26 green leaves kg⁻¹ while minimum green leaves/kg (20) recorded in Rustica-19.

Cured weight plot⁻¹ maximum cured weight plot⁻¹ (2.43kg) found in Rustica-19 while minimum cured weight plot⁻¹ (1.57 kg) found in Rustica-Hazro.

Number of cured leaves kg⁻¹ maximum cured leaves kg⁻¹ (231) observed in Rustica Hazro while minimum cured leaves kg⁻¹ (124) observed in Rustica-19.

Yield hectare⁻¹ (kg) maximum **yield hectare⁻¹** (5816 kg) recorded in Rustica-19 while minimum yield/hectare (3771 kg) recorded in Rustica-Hazro.

Nicotine % maximum nicotine (3.42%) recorded in Rustica-14 while minimum nicotine (3.35 %) recorded in Rustica-Hazro.

Reducing Sugar content maximum reducing sugar (5.4 %) observed in Rustica-19 while minimum reducing sugar (5.3 %) observed in Rustica-Jampur.

Table: 3:-Mean Table of Agronomic Parameters of Rustica Varietal Trial (II)

Treat./Var.	Plant Height (cm)	Leaf Area (cm ²)	Leaves Plant ⁻¹	Green Weight Plot ⁻¹ (kg)	Green Leaves kg ⁻¹	Cured Weight Plot ⁻¹ (kg)	Cured Leaves kg ⁻¹	Yield hectare ⁻¹ (kg)
Rustica 14	58	584	11	11.8	26	2.04	162	4899
Rustica Hazro	67	607	12	9.4	30	1.57	231	3771
Rus Jampur	53	570	9	10.4	21	2.17	125	5203
Rustica 19	56	597	10	13	20	2.43	124	5816
R-Rasoolabad	55	592	10	12	25	1.92	156	4616

Table: 4:-

Mean Table of Chemical Analysis of Rustica Varietal Trial (II)

Treatments	Nicotine (%)	Reducing Sugar (%)
Rustica-Hazro	3.35	5.2
Rustica-Jampur	3.27	5.0
Rustica-14	3.42	5.3
Rustica -19	3.29	5.4
Rustica-Rasoolabad	3.31	5.2

Conclusion:

The research data mentioned in table 1-4 is for the year 2020-21 for agro-climatic condition of Mardan. Therefore this year Rustica-19, produced highest yield of 5818 kg followed by Rustica-Swabi and all yield related parameters were also high in mentioned varieties with balanced nicotine and reducing sugar. Variations are possible depending upon area and climatic conditions in future. Morphology and physiology of all the varieties was good but varieties with greater yield comparatively were comparatively good in all characteristics.

TITLE NO. 3: EVALUATION OF DIFFERENT VARIETIES OF RUSTICA TOBACCO AT BUNER MODEL FARM

This was the 1st year of trial to evaluate the performance related to yield at Buner model Farm. Plant material comprised of 05 Rustica varieties viz; Rustica-Bubak, Rustica-Hazro, Rustica-19, Rustica-13 and Rustica-14. All the recommended agronomic practices were performed. Results revealed from mean values (Table 5) are given as under:

Plant height (cm) maximum plant height (39.67 cm) observed in Rustica-Hazro followed by Rustica-14 with plant height (**39 cm**) while minimum plant height (**33 cm**) observed in Rustica-19

Leaf area (cm²) maximum leaf area (174 cm²) recorded in Rustica-13 followed by rustica-14 while minimum leaf area (117 cm²) recorded in Rustica-19.

Rustica was topped on different leaves plant⁻¹ so Maximum numbers of leaves plant⁻¹ (10) found in Rustica-13, Rustica-19 & Rustica-14 (10) while minimum numbers of leaves plant⁻¹ (9) in Rustica-Hazro and Rustica-Bubak (9).

Green weight plot⁻¹ (kg) maximum green weight plot⁻¹ (3.46 kg) observed in Rustica-14 while minimum green weight plot⁻¹ (2.47 kg) observed in Rustica-Hazro.

Number of green leaves kg⁻¹ maximum green leaves kg⁻¹ (183) recorded in Rustica-Bubak followed by Rustica-Hazro with 129 green leaves kg⁻¹ while minimum green leaves kg⁻¹ (102) was recorded in Rustica-13.

Cured weight plot⁻¹ maximum cured weight plot⁻¹ (1.005kg) found in Rustica-14 while minimum cured weight plot⁻¹ (0.66 kg) found in Rustica-Hazro.

Number of cured leaves kg⁻¹ maximum cured leaves kg⁻¹ (672) observed in Rustica Bubak while minimum cured leaves kg⁻¹ (512) observed in Rustica-14.

Varieties	Leaf Area(Cm ²)	Plant Height(Cm)	Leaves Plant ¹	Green Weight Plot ¹ (kg)	Green Leaves Kg ⁻¹	Cured Weight Plot ¹ (Kg)	Cured Leaves Kg ⁻¹	Yield hectaere ⁻¹ (kg)
Rus-13	174	37	10	3.44	102	0.81	550	1934
R-Hazro	152	39.67	9	2.47	129	0.66	519	1582.2
R-Bubak	162	38.67	9	2.82	183	0.70	672	1658.34
Rus-19	117	33.34	10	2.74	109.34	0.72	521	1709
Rus-14	173	39	10	3.46	104	1.005	512	2412

Yield hectare⁻¹ (kg) maximum yield hectare⁻¹ (2412 kg) recorded in Rustica-14 while minimum yield hectare⁻¹ (1582 kg) recorded in Rustica-Hazro.

TITLE NO 4: RUSTICA TOPPING HEIGHT TRIAL

Material and methodology

The experiment was carried out on the “Rustica Topping Height” at the Tobacco Research Station, Khan Garhi, Mardan (2020-21), using randomized complete block design, replicated thrice. Treatments included three topping levels T₁= 10 leaves, T₂ = 12 leaves and T₃ = 14 leaves on Rustica-13 variety. As topping practice stimulates root growth, the source of nicotine, which improves drought tolerance. In addition, topping increases yield through increased growth, especially of the upper leaves. Topping stimulates the production of secondary plant products that accumulate in the leaves. These products give the cured leaf improved quality and smoking characteristics. In order to evaluate chemical and physical properties of Rustica tobacco the experiment was laid out to meet the following objectives.

Objectives

- To set the optimum stage for topping for Rustica crop.
- To determine difference in yield and chemical properties of cured leaves due to varying the height of topping.

Leaf area (cm²) 12 leaves topping height treatment plot gave maximum leaf area (653 cm²), however, 2nd highest leaf area observed in 10 leave topping height treatment plot (649cm²). Illustrated in table 06.

Green weight plot⁻¹ (kg) is very important parameter of yield determination. Maximum green weight plot⁻¹ (22.2 kg) observed in 14 leave topping height treatment plot followed by green weight plot⁻¹ (16.6 kg) in 12 leave topping height treatment plot.

Green leaves kg⁻¹ maximum green leaves kg⁻¹ 22 were observed at 14 leaves while Minimum green leaves kg⁻¹ (18) were observed in 10 leaves topping height treatment plot.

Cured weight plot⁻¹ (kg) is also very important parameter of yield determination. Maximum cured weight plot⁻¹ (2.9 kg) observed in 14 leaves topping height treatment plot, followed by cured weight plot⁻¹ (2.3 kg) in 12 leaves topping height treatment plot.

Cured leaves kg⁻¹ is also very important parameter of yield determination. Maximum cured leaves kg⁻¹ (161) observed in 14 leaves topping height treatment plot, followed by cured leaves kg⁻¹ (156) in 12 leaves topping height treatment plot. While least cured leaves kg⁻¹ (147) observed at topping at 10 leaves.

Cured yield kg ha⁻¹ presented in table (6) which indicated that mean values for highest yield was gained by 14 leaves topping height treatment plot (6320 kg) followed by 12 leaves topping height treatment plot (5552 kg).

Nicotine % described in table 6, maximum nicotine content observed in 10 leaves topping height treatment plot (3.54%).

Reducing sugars showed in table 6 maximum mean value of reducing sugar observed in 14 leaves topping height treatment plot (5.3%).

Conclusion:

It is pertinent to mentioned that the data mentioned in table 6 is for the year 2020-21 for agro-climatic condition of Mardan, Therefore this year Rustica-13, topped at 14 leaves produced highest yield of 6320 kilograms hectare⁻¹ and chemical parameters with balanced nicotine and reducing sugar. Variations are possible in other areas in future according to climatic condition.

D. PLANT PROTECTION SECTION

1. PLANT PATHOLOGY

TITLE NO. 1: BIOLOGICAL CONTROL OF DAMPING OFF DISEASE IN TOBACCO THROUGH *TRICHODERMA* SPP. IN COMBINATION WITH CHEMICAL CONTROL AT TOBACCO RESEARCH STATION, MARDAN

Treatments

1. Ridomil Gold
2. *Trichodermaharzanium*
3. Ridomil Gold + *Trichodermaharzanium*
4. Control

Methodology

The above mentioned treatments were applied in field at 15 days interval.

Results

Due to crop damage occurred by hailstorm during crop season (2020-21) in Mardan, no data could be collected.

2. ENTOMOLOGY SECTION

TITLE NO. 1: **PERFORMANCE OF DIFFERENT INSECTICIDES FOR THE CONTROL OF APHID**

Variety: K-399

Design: RCBD design with 3 treatments and 4 replications

Treatments:

T₁: Acetamiprid 20% SP

T₂: Dinotefuran (Oshin) 20 SG

T₃: Control

Methodology:

The following methodology adopted for the data collection.

- Five plants were randomly selected.
- The insect eggs, larvae and adults were counted on the leaves selected from top, middle, and bottom of the plant.

Insects were count before insecticide application (pre-treatment)

- After 24 hours of Insecticide application (Post –treatment)
- After 48 hours of Insecticide application (Post –treatment)
- After 72 hours of Insecticide application (Post –treatment)

Objectives:

- The following study conducted for the comparison of new chemistry pesticides with acetamiprid for the control of APHID

Persons Associated: Plant Protection Section

Duration: 2nd year of trial (2020-2023)

Statistical Analysis:

The means \pm SD were analyzed by GraphPad Prism® (Version 5.0; GraphPad Software, Inc., La Jolla, CA, USA) software. The effects of different insecticides on APHID attack were evaluated with two-way analysis of variance (ANOVA) for repeated measurements (treatment \times hours) and Tukey test was used as post-hoc analyses. The level of statistical significance was set at $p < 0.05$.

Results:

The 24, 48 and 72 hours' performance of different insecticides showed a significant decrease (<0.0001) in APHID attack in comparison to control and pre-treatment groups (Table 1 and 2). The performance of acetamiprid 20% SP and dinotefuran (Oshin) 20% in comparison to control after 24, 48 and 72 hours is shown Figure 1, 2 and 3 respectively. After 72 hours, the most significant decrease was observed with acetamiprid 20% SP in comparison to pre-treatment group (Figure 3). However; control pre and post treatment group did not show any significant effects in 24, 48 and 72 hours (Figure1, 2 and 3).

Table 1: The descriptive statistics of different insecticides for the control of APHID

Groups	Acetamiprid 20% SP	Dinotefuran (Oshin) 20% SG	Control
Number of values	4	4	4
Minimum	33.83	38.67	127.6
Maximum	133.2	140.0	143.4
Range	99.33	101.3	15.83
10% Percentile	33.83	38.67	127.6
90% Percentile	133.2	140.0	143.4
95% CI of median			
Actual confidence level	87.50%	87.50%	87.50%
Lower confidence limit	33.83	38.67	127.6
Upper confidence limit	133.2	140.0	143.4
Mean	81.56	91.83	135.2

Std. Deviation	42.51	43.30	7.726
Std. Error of Mean	21.26	21.65	3.863
Lower 95% CI of mean	13.92	22.94	122.9
Upper 95% CI of mean	149.2	160.7	147.5
Coefficient of variation	52.12%	47.15%	5.714%

Table 2: The Two-way ANOVA of different insecticides for the control of APHID

Source of Variation	% of total variation	P value	F (DFn, DFd)	P value summary
Interaction	13.16	<0.0001	F (6, 132) = 32.44	****
Treatment	44.56	<0.0001	F (3, 132) = 219.8	****
Hours	33.36	<0.0001	F (2, 132) = 246.7	****

Post-Hoc Tukey's Test

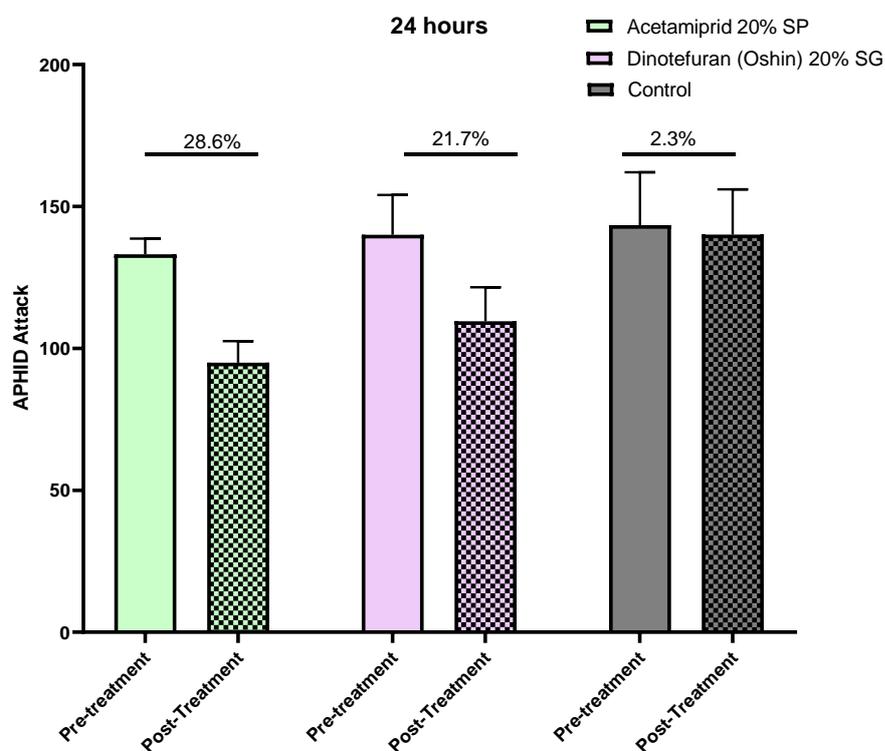


Figure 1: The effects of different insecticides on APHID attack after 24 hours.

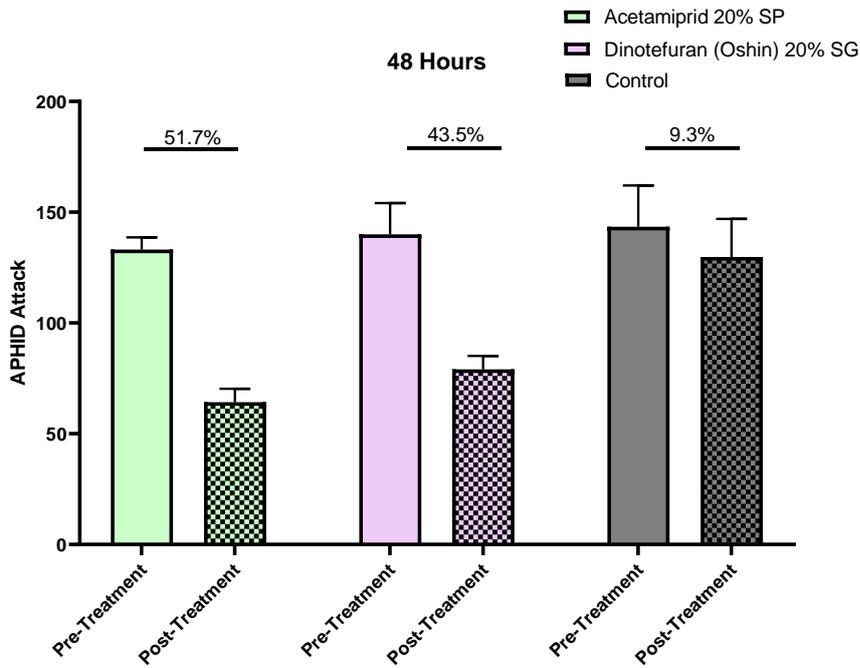


Figure 2: The effects of different insecticides on APHID attack after 48 hours.

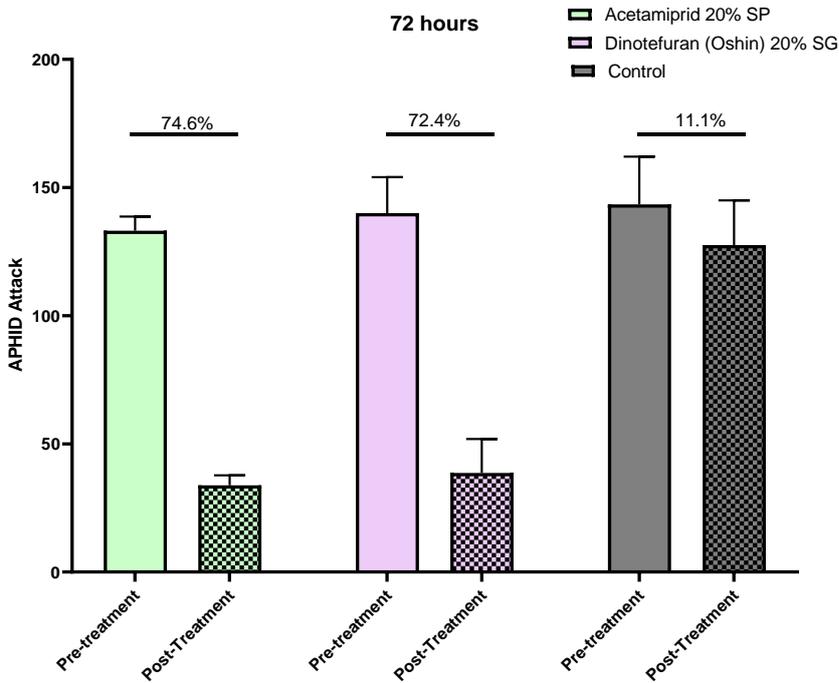


Figure 3: The effects of different insecticides on APHID attack after 72 hours.

Conclusion

Sr. No.	Treatments	Control % (2020-21)
1	Acetamiprid 20% SP	74.67A
2	Dinotefuran (Oshin) 20% SG	72.83B
3	Control	-

Thus, the above results showed that Acetamiprid 20% SP significantly decreased (74.67%) the APHID attack in comparision to Dinotefuran (Oshin) 20% SG (72.83%).

3. PHYSIOLOGY SECTION

TITLE NO. 1: THE EFFECT OF DIFFERENT TRANSPLANTATION DATES ON TOBACCO CONVENTIONAL VARIETIES

Methodology

The experiment laid out in RCBD factorial design with three replications having plant to plant and row to row distance of 2ft and 3ft, respectively. The FCV conventional varieties K-399 and Spt.G-28 with four treatments were used in the trail.

T₁: Last week of February

T₂: 15 March

T₃: 2nd week of April

T₄: Last week of April

V₁T₁

V₁T₂

V₁T₃

V₁T₄

V₂T₁

V₂T₂

V₂T₃

V₂T₄

Agronomical Parameters

Due to a hailstorm during last year in June, the data (except one picking) could not be collected as the crop was completely damaged. That's why no proper result can be given.

Chemical Analysis

Chemical analysis for the above trial was performed only from bottom leaves (1st Picking). From the available leaves samples, the highest (2.85 %) nicotine content was observed in V₁T₁, while the lowest (1.92 %) nicotine content was recorded in V₁T₃ (Table 1). Whereas, the highest (12.86) reducing sugar % was observed in V₂T₃, while the lowest (10.07) was observed in V₁T₁ (Table 1).

TITLE NO. 2: DROUGHT TOLERANCE AMONG DIFFERENT HOMOZYGOUS LINES OF FCV TOBACCO

Material and method

Field experiment carried out to screen out the drought tolerance lines among FCV tobacco homozygous lines at Tobacco Research Station Khan Garhi, Mardan during 2020-21 using Randomized Complete Block (RCB) design arrangement replicated thrice. Eight homozygous lines with a check variety K-399 were sown under somehow drought condition.

Agronomical Parameters

Crop damaged due to severe hailstorm only parameters mentioned in table 2 were recorded. maximum leaf area (811 cm²) was recorded in K-399, while minimum leaf area (712 cm²) was observed in E₅.

Chemical Analysis

Chemical analysis for this trial analysed only from bottom leaves (1st picking). From the available leaves samples, the highest Nicotine content (2.86 %) estimated in E₃, while the lowest nicotine content (2.24 %) calculated in E₄ (Table 3). Likewise, the highest reducing sugar % (11.6) observed in E₅ while the lowest reducing sugar % (8.3) recorded in K-399 (Table 3).

Table 1: Chemical analysis of 1st picking (Bottom leaves) from different transplantation dates trial

S.No	Treatments	Nicotine %	Reducing sugar %
1	V ₁ T ₁	2.85	10.07
2	V ₁ T ₂	2.31	11.00
3	V ₁ T ₃	1.92	11.43
4	V ₁ T ₁	2.42	12.04
5	V ₂ T ₁	2.00	12.37
6	V ₂ T ₂	1.99	12.76
7	V ₂ T ₃	2.39	11.73
8	V ₂ T ₄	2.44	12.42

Table 2: Drought tolerance among conventional FCV tobacco variety and different homozygous lines

S.No	Treatments	Plant Height (cm)	Number of leaves plant ⁻¹	Leaf area (cm ²)	Green weightt plot ⁻¹ (kg)	Green leaves Kg ⁻¹	Cured weightt plot ⁻¹ (kg)	Cured leaves Kg ⁻¹	Yield Hectare ⁻¹ (Kg)
1	E ₁	-	-	758	-	-	-	-	-
2	E ₂	-	-	763	-	-	-	-	-
3	E ₃	-	-	775	-	-	-	-	-
4	E ₄	-	-	798	-	-	-	-	-
5	E ₅	-	-	712	-	-	-	-	-
6	E ₆	-	-	720	-	-	-	-	-
7	E ₇	-	-	762	-	-	-	-	-
8	E ₈	-	-	760	-	-	-	-	-
9	K-399	-	-	811	-	-	-	-	-

*Data from 1st picking (Bottom leaves)

Table 3: Chemical analysis of 1st picking (Bottom leaves) from Drought tolerance from different homozygous lines of FCV tobacco.

S.No	Treatments	Nicotine %	Reducing sugar %
1	E ₁	2.85	8.6
2	E ₂	2.39	10.5
3	E ₃	2.86	10.9
4	E ₄	2.24	10.2
5	E ₅	2.52	11.6
6	E ₆	2.51	10.7
7	E ₇	2.55	9.7
8	E ₈	2.55	11.1
9	K-399	2.85	8.3

4. AGRONOMY SECTION

TITLE NO. 1: EFFECT & COMPARISON OF MANUAL HOEING AND CHEMICAL WEEDICIDE CONTROL ON PRODUCTION OF TOBACCO (FCV)

Importance:

Agriculture is the mainstay of Pakistan's economy. Its share in GDP is 24%. Tobacco production in Pakistan has long tradition and for many families it is the basic source of living. Tobacco makes a significant contribution in different sectors of the economy. Its total income contribution to GDP is Rs 27.5 billion (4.4 % of the total GDP). Weeds compete with crop plants for nutrients, soil moisture, space and sunlight and hence reduce yield. Most of the weeds are more

competitive than the crop plants. Reduction in tobacco yield has a direct correlation with weed competition. Generally, an increase in one kilogram of weed growth corresponds to a reduction in one kilogram of crop growth. Therefore, to find out the most suitable method of weed control is very important.

Detailed Work Plan: The experiment was conducted in RCB design with three replications.

Treatments:

- T₁: Control
- T₂: Manual Hoeing (Three times in whole growing season)
- T₃: Mechanical Hoeing (Two times)
- T₄: Pre-Emergence Herbicide (STOMP 330 EC)
- T₅: Post Emergence Herbicide (Topik 15WP)
- T₆: Pre-Emergence Herbicide after stress period (1.5l/ha)

Note:- No data was recorded due to hail storm damaged all the crop of Tobacco Research Station, Mardan.

TITLE NO. 2: **EVALUATION OF ECONOMICAL AND BEST GROWTH CULTURE MEDIA FOR TOBACCO SEEDLINGS IN SEEDLING TRAYS**

Importance:

It is undisputed that healthy growing seedlings are the basis of a good tobacco crop. To improve tobacco production is necessary good agricultural practice, which involves the implementation of new technologies for production of tobacco seedlings. Float Tray system technology of tobacco seedlings production is one of the key prerequisites for quality production. During the vegetation, a large number of factors have an impact on the tobacco that allow or interfere on the tobacco plant to express its biological and production potentials. Except the biological potential of the varieties, the largest influences have taken scientific farming methods and agro ecological conditions during the growing season. Tobacco growers must begin with production of healthy seedlings, in order to achieve good quality and high yield per unit area. The high-quality seedlings are produced with Float Tray System technology, production which presents hydroponic system of growing tobacco seedlings on sterile substrate in medium with fertilizers and protection. The tobacco seedlings are quite uniform according to their morphological and biological characteristics, especially when tobacco has been transplanted on the field. Tobacco in the field depends on its well-developed root system and morphological uniformity in terms of its dimensions (Pearce & Palmer, 2005). The float system, besides being eco-friendly, is associated with many other benefits including a reduction in seed bed area and water requirement, more efficient use of

fertilizers, and the production of superior robust seedlings that can better withstand harsh field transplanting agroclimatic conditions.

Detailed Work Plan: The experiment was conducted in RCB design with three replications.

Treatments:

T₁: Control: Normal Seed bed
 T₂: FYM+ Soil: (50:50)
 T₃: Slurry+ Soil: (50:50)
 T₄: Slurry: 100%
 T₅: FYM: 100%
 T₆: Rice Hull
 T₇: Wheat Straw
 T₈: Coco Peat

1. Fungicide applied: Champion WP was applied on all media's before sowing and 15g Champion WP was applied to float tray system to avoid algal and fungal growth.

2. Date of Sowing: December 10, 2020.

3. Refilling: Refilling was done on 26-01-2021.

4. Clipping of Nursery: 16-03-2021.

5. Transplantation: 22-03-2021.

6. Fertilizer Applied:

<u>Date</u>	<u>Fertilizer</u>	<u>Quantity</u>
11-01-2021	DAP	1g/tray
26-01-2021	NPK	1g/tray
10-02-2021	NPK	1g/tray
05-03-2021	NPK	1g/tray

Table No. 1 Disease attack in trays:

Date	Normal Seedbed	Cocopeat	Baggas Ash	Baggas Ash+Soil	Slurry	Slurry+ Soil	Rice Hull
03-01-2021	Nil	Nil	Nil	Nil	Damping off	Nil	Nil
10-01-2021	-do-	-do-	-do-	-do-	Moderate	-do-	-do-
15-01-2021	-do-	-do-	-do-	-do-	-do-	-do-	-do-
22-01-2021	-do-	-do-	-do-	-do-	High	-do-	-do-
26-01-2021	-do-	-do-	-do-	-do-	-do-	-do-	-do-

Damping off disease was observed in Slurry applied in Nursery.

Table No. 2 Weed Density per ft²:

Date	Normal Seedbed	Cocopeat	Baggas Ash	Baggas Ash+Soil	Slurry	Slurry+ Soil	Rice Hull
03-01-2021	5	0	0	0	0	0	0
10-01-2021	8	0	1	0	2	0	1
15-01-2021	10	0	2	0	2	1	1
22-01-2021	15	0	2	0	2	3	1
26-01-2021	15	0	2	0	2	3	1

Maximum weed density per ft² was recorded in normal seed bed followed by Slurry+Soil Nursery.

Table No. 3 Weed Biomass gm/ft²:

Date	Normal Seedbed	Cocopeat	Baggas Ash	Baggas Ash+Soil	Slurry	Slurry+ Soil	Rice Hull
22-01-2021	1.5	0	0.02	0	0.01	0.03	0.02

Maximum weed biomass gm/ft² was recorded in normal seedbed followed Slurry+Soil Nursery.

Table No. 4 Germination started on January 03, 2021:

Date	Normal Seedbed	Coco-peat	Baggas Ash	BaggasAsh +Soil	Slurry	Slurry+ Soil	Rice Hull
03-01-2021	55%	50%	10%	20%	20%	40%	20%
10-01-2021	70%	70%	30%	50%	50%	45%	50%
15-01-2021	75%	73%	50%	70%	65%	50%	70%
22-01-2021	81%	81%	70%	81%	79%	63%	80%
26-01-2021 Refilling	Nil	100%	100%	100%	100%	100%	100%

From the above table, it is cleared that after 20days (03-01-2021) of seed sowing in different media's maximum germination 55% was recorded in normal seed bed followed by cocopeat, which

was 50%. Above 80% germination was recorded in Normal Seedbed, Cocopeat, Baggas ash+ soil and Rice hull. Refilling was done in all Medias.

Table No. 5 Nursery growth:

Date	Normal Seedbed		Cocopeat		Baggas Ash		Baggas Ash +Soil		Slurry		Slurry+Soil		Rice Hull	
	Height Inches	No. of leaves	Height Inches	No. of leaves	Height Inches	No. of leaves	Height Inches	No. of leaves	Height Inches	No. of leaves	Height Inches	No. of leaves	Height Inches	No. of leaves
07-02-21	1	3	0	2	0	2	0	2	0	2	0	2	0	2
20-02-21	1.5	4	1	3	0.8	3	1	3	0.7	4	1	4	1.5	4
05-03-21	4	6	4	6	1.7	4	3	6	2.5	5	3	6	3.5	5
18-03-21	6	8	5	7	4	5	6	7	4.5	6	5	8	5	7

Table-5 showed that maximum height of 6 inches was recorded in Normal Seedbed followed by Cocopeat, Baggasash+soil, Slurry+Soil and Rice Hull and minimum was noted in Baggasash+Soil. Similarly, the maximum no of leaves i.e. 8 were recorded in Normal seed bed and Slurry+Soil and same no of leaves i.e., 7 leaves were recorded in Cocopeat, Baggasash+Soil and Rice Hull.

II. TOBACCO RESEARCH SUB-STATION (TRSS), MANSEHRA

A. PLANT BREEDING & GENETICS SECTION

TITLE NO. 1: EVALUATION OF EXOTIC HYBRID GENOTYPES IN AGRO-CLIMATIC CONDITIONS OF MANSEHRA

Methodology

The seven exotic genotypes namely **17x199, 17x202, RJR-213, RJR-217, RJR-901 and Spt.G.28** were laid out at Tobacco Research Sub Station Mansehra in a randomized complete block design (RCBD) with three replications, Plant to plant and row to row distance maintained as recommended. Following eleven (11) characters were recorded,

1. Days to 50% flowering
2. Plant height (cm)
3. Number of leaves plant⁻¹
4. Leaf area (cm²)
5. Green weight plot⁻¹ (Kg)
6. Green leaves kg⁻¹
7. Cured weight plot⁻¹ (Kg)
8. Cured leaves kg⁻¹
9. Cured yield ha⁻¹ (Kg)
10. Reducing sugars %
11. Nicotine%.

Data Analysis:

The values of mean squares were obtained according to Gomez and Gomez (1984) and the Pearson's correlation coefficients were calculated for each pair of traits by using Statistx 8.1 software.

Mean Squares:

Mean squares of hybrid genotypes from ANOVA were carried out for 11 parameters recorded which affect the tobacco yield directly or indirectly. Mean Squares displayed that all the characters including: days to 50% flowering, plant height (cm), leaves plant⁻¹, leaf area (cm²) green weight plot⁻¹ (Kg) green leaves kg⁻¹ cured weight plot⁻¹(Kg), cured leaves kg⁻¹, nicotine % reducing Sugars content, cured yield ha⁻¹ (Kg) were exhibited highly significant differences at (P<0.01) for all examined genotypes showed in **Table 1**.

Table 1 Mean Squares of different characters of hybrid genotypes

Source of variation	Replications	Genotypes	Error
Degrees of freedom	2	6	09
Days to 50% flowering	2.333	137.857***	2.00
Plant height (cm)	0.385	142.414***	3.541
Number of leaves plant ⁻¹	6.7605	29.1041***	1.5760
Leaf area (cm ²)	2.70	8406.09***	5.27
Green weight plot (Kg)	0.04590	6.35342***	0.19852

Green leaves (Kg)	8.1817	20.9975^{NS}	11.3284
Cured weight plot⁻¹ (kg)	0.00045	0.16082***	0.00056
Cured leaves kg⁻¹	222.970	885.315**	179.258
Nicotine%	0.00236	0.26826***	0.00049
Reducing sugar content	1.69989	8.68554***	0.01389
Cured yield ha⁻¹ (Kg)	1457	517169***	1810

Note : *** = Highly Significant at (P<0.01), ^{NS} = Non Significant

Table 2 Mean performance of hybrid genotypes

Genotype	50% Days to flowering	Plant height (cm)	Leaf area (cm ²)	Number of Leaves Plant ⁻¹	Green weight plot ⁻¹ (kg)	Green leaves kg ⁻¹	Cured weight plot ⁻¹ (kg)	Cured leaves kg ⁻¹	Yield Ha ⁻¹ (kg)	Nicotine%	Reducing Sugars %
17x199	92.00B	72.06 D	554.35 F	23.13 CD	7.22 C	27.22 ABC	1.92 B	104.80 B	3451.5 B	2.47 C	12.11 C
17x202	83.33D	81.06 B	580.97 D	19.50 E	7.44 C	29.42 ABC	1.80 C	126.26 AB	3234.3 C	2.92 A	11.38 D
RJR-213	88.00 C	87.23 A	599.58 C	22.76 CD	8.55 B	26.16 BC	1.91 B	106.40 B	3441.9 B	2.36 D	12.19 C
RJR-217	95.00 A	77.10 C	512.62 G	28.83 A	7.02 CD	32.20 A	1.57 E	143.05 A	2822.7 E	2.24 E	14.06 B
RJR-215	93.33 AB	68.30 E	562.67 E	24.56 BC	9.17 B	27.22 ABC	1.47 F	145.08 A	2645.1 F	2.54 B	15.45 A
RJR-901	82.66 D	84.67 A	669.03 A	21.00 DE	6.17 D	31.27 AB	1.63 D	124.88 AB	2924.3 D	2.21 E	10.62 E
Speight G-28	76.33 E	74.01 CD	639.08 B	25.93 B	10.47 A	25.04 C	2.13 A	106.81 B	3820.9 A	2.94 A	13.87 B
LSD (P<0.05)	2.5159	3.3478	4.0853	2.2334	0.7926	5.9877	0.0422	23.818	75.681	0.0394	0.2096

Means followed by different letters in each rows are significantly different at (P< 0.05) level of probability followed by Duncan's multiple range test (DMRT).

Mean performance

Days to 50% flowering

More days to flowering **95** days were taken by genotype **RJR-217** and less number **76** days to 50% flowering were taken by genotype **Speight G-28** as Shown in **Table 2**.

Plant height (cm)

the taller plants measured (**87.23 cm**) in genotypes **RJR-213** and dwarf (**68.30 cm**) plants found in genotype **RJR-215** as described in **able 2**.

Leaf Area (cm⁻²)

Large leaf area measured (**669.03 cm⁻²**) in genotype **RJR-901** and small leaf area measured (**512.62 cm⁻²**) in candidate genotype **RJR-217** as detailed in **Table 2**.

Number of leaves plant⁻¹

Higher number of leaves plant⁻¹ (**28.83**) was seen in lines **RJR-217** and lesser number (**19.50**) of leave plant⁻¹ seen in **17x202** shown in **Table 2**.

Green weight plot⁻¹ (Kg)

According to the **Table 2** higher green weight plot⁻¹ weighed (**10.47 kg**) in genotype **Speight G-28** and minimum green weight plot⁻¹ weighed (**6.17 kg**) in genotype **RJR-901**.

Green Leaves Kg⁻¹

As shown in **Table 2** the maximum green leaves kg⁻¹ were counted (**32.20**) in hybrid **RJR-217** and minimum green leaves kg⁻¹ were counted (**25.04**) in **Speight G-28**.

Cured weight plot⁻¹ (kg)

The higher cured weight plot⁻¹ weighed (**2.13 Kg**) in genotypes **Speight G-28** and low green weight plot⁻¹ weighed (**1.47 Kg**) in **RJR-215**.

Cured leaves kg⁻¹

A maximum number of cured leaves kg⁻¹ counted (**145**) in **RJR-215** and minimum number of leaves kg⁻¹ were counted (**104**) in hybrid **17x199** as detailed **Table 2**.

Cured yield Hectare⁻¹ (Kg)

The optimum cured yield ha⁻¹ weighed (**3820.9 Kg**) in commercially cultivated genotype **Speight G-28** and minimum cured yield ha⁻¹ weighed (**2645.1 Kg**) in genotype **RJR-215** shown in **Table 2**.

Nicotine %

Higher nicotine % was tested (**2.94%**) in genotype **Speight G-28** while low nicotine content (**2.21%**) found in **RJR-901**, described in **Table 2**

Reducing sugars %

From **Table 2** high sugars noted (**15.45%**) in genotype **RJR-215** and low sugar content resulted (**10.62%**) in genotype **RJR-901**.As shown in **Table 2**.

Table 3 Correlation coefficient

Characters	Days to flowerin g	Leaves plant ⁻¹	Plant height	Leaf area	Green weight plot ⁻¹	Green leaves kg ⁻¹	Cured weight plot ⁻¹	Cured leaves kg ⁻¹	Yield ha ⁻¹	Nicotine %
Leaves plant ⁻¹	0.2996 ^{NS}									
Plant height	-0.2794 ^{NS}	-0.4261*								
Leaf area	-0.8186***	-0.4436*	0.4155 ^{NS}							
Green weight plot ⁻¹	-0.3432 ^{NS}	0.2471 ^{NS}	-0.3567 ^{NS}	0.1373 ^N _S						
Green leaves kg ⁻¹	0.2317 ^{NS}	0.1065 ^{NS}	0.0630 ^{NS}	-0.1524 ^N _S	-0.6656*					
Cured weight plot ⁻¹	-0.6121**	-0.940 ^{NS}	0.1341 ^{NS}	0.3464 ^N _S	0.4526*	-0.5027*				
Cured leaves kg ⁻¹	0.3769 ^{NS}	0.1177 ^{NS}	-0.2590 ^{NS}	-0.3520 ^N _S	-1522 ^{NS}	0.4581*	-0.7439** _*			
Yield ha ⁻¹	-0.6121**	-0.0940 ^{NS}	0.1341 ^{NS}	0.3464 ^N _S	0.4526*	-0.5027*	1.000***	-0.7439** _*		
Nicotine%	-0.5751**	-0.1685 ^{NS}	-0.2877 ^{NS}	0.1448 ^N _S	0.5862* _*	-0.3582 ^N _S	0.5336**	-0.2227 ^{NS}	0.5336* _*	
Reducing sugars %	0.3654 ^{NS}	0.6932** _*	-0.6895** _*	-0.4583*	0.5749* _*	-0.0738 ^N _S	-0.2408 ^{NS}	0.348 ^{NS}	-0.2408 ^N _S	0.1280 ^{NS}

Note: **** = highly significant; ** = highly significant at (1%) probability level; * = significant at (5%) probability level; ^{NS} = Non Significant

DESCRIPTION OF CORRELATION COEFFICIENT

Days to 50% flowering V/S number of leaves plant⁻¹

The relationship indicated positive but non-significant correlation ($r = 0.2996^{\text{NS}}$) with number of leaves plant⁻¹.

Days to 50% flowering V/S plant height

Negative and non-significant relationship ($r = -0.274^{NS}$) was observed between days to 50% flowering with plant height.

Days to 50% flowering V/S leaf area

Relationship between days to 50% flowering with leaf area ($r = -0.8186^{***}$) was found undesirable and highly significant.

Days to 50% flowering V/S green weight plot⁻¹

Inter-relationship indicates negative and non-significant ($r = -0.3432^{NS}$) correlation between days to 50% flowering with green weight plot⁻¹.

Days to 50% flowering V/S green leaves kg⁻¹

Interconnection between days to 50% flowering with green leaves Kg⁻¹ was observed ($r = 0.2317^{NS}$) positive but insignificant

Days to 50% flowering V/S cured weight plot⁻¹

Negative but significant ($r = -0.6121^{**}$) relationship between days to 50% flowering and cured weight plot⁻¹ was observed.

Days to 50% flowering V/S cured leaves kg⁻¹

Positive but not important relation ($r = 0.3769^{NS}$) between days to 50% flowering and cured leaves Kg⁻¹ was recorded.

Days to 50% flowering V/S yield ha⁻¹

Negative and important connection ($r = -0.6121^{**}$) between 50% days to flowering and yield ha⁻¹ resulted.

Days to 50% flowering V/S nicotine

The association between 50% days to flowering with nicotine% was unsuitable and highly significant ($r = -0.5751^{**}$) with each other.

Days to 50% flowering V/S reducing sugars

Relationship revealed positive and ignorable ($r=0.3654^{NS}$) association between both the traits.

Number of leaves plant⁻¹ V/S plant height

Association suggested negative and noticeable relation ($r= -0.4261^*$) between number of leaves plant⁻¹ and plant height.

Number of leaves plant⁻¹ V/S leaf area

There was significant and non-positive association ($r= -0.4436^*$) between number of leaves plant⁻¹ and leaf area.

Number of leaves plant⁻¹ V/S green weight plot⁻¹

Relationship illustrated positive but negligible relation ($r = 0.2471^{NS}$) between studied traits.

Number of leaves plant⁻¹ V/S green leaves kg⁻¹

There was positive but insignificant association ($r= 0.1065^{NS}$) found between the parameters.

Number of leaves plant⁻¹ V/S cured weight plot⁻¹

The association between number of leaves plant⁻¹ and cured weight plot⁻¹ revealed negative and negligible ($r = -0.940^{NS}$).

Number of leaves plant⁻¹ V/S cured leaves kg⁻¹

Interrelationship between number of leaves plant⁻¹ and cured leaves kg⁻¹ was positive but ignorable ($r =0.1177^{NS}$).

Number of leaves plant⁻¹ V/S yield ha⁻¹

The correlation between number of leaves plant⁻¹ v/s Yield ha⁻¹ resulted unfavorable as well insignificant (-0.0940^{NS}) relationship.

Number of leaves plant⁻¹ V/S nicotine

Undesirable and non-significant association ($r= -0.1685^{NS}$) found between number of leaves plant⁻¹ and Nicotine%

Number of leaves plant⁻¹ V/S reducing sugars

Correlation coefficient (r) between number of leaves plant⁻¹ and reducing sugars revealed highly desirable as well positive (r= 0.6932^{**})

Plant height V/S leaf area

Association between plant height v/s leaf area illustrated positive and non-significant (r= 0.4155^{NS}) association.

Plant height V/S green weight plot⁻¹

The relationship was unfavorable and non-significant (r = -0.3567^{NS}) showed between parameters.

Plant height V/S green leaves kg⁻¹

Positive but not important relationship (r = 0.0630^{NS}) observed between plant height and green leaves kg⁻¹

Plant height V/S cured weight plot⁻¹

The interrelationship (r= 0.1341^{NS}) positive and non-significant between plant height and cured weight plot⁻¹.

Plant height V/S cured leaves kg⁻¹

Undesirable and non-significant association (r = -0.2590^{NS}) found in plant height and cured leaves kg⁻¹.

Plant height V/S yield ha⁻¹

Correlation coefficient (r) indicated (r= 0.532^{NS}) positive but non-significant relationship in plant height with yield ha⁻¹.

Plant height V/S Nicotine

The association indicated unpleasant but insignificant (r = -0.2877^{NS}) relationship between plant height and nicotine

Plant height V/S reducing sugars

Plant height v/s reducing sugar relationship revealed negative but highly significant (r = -0.6895^{***}).

Leaf area V/S green weight plot⁻¹

Favorable but non-significant ($r = 0.1373^{NS}$) association observed between leaf area and green weight plot⁻¹.

Leaf area V/S green leaves kg⁻¹

Relationship revealed negative and non-significant ($r = -0.1524^{NS}$) relationship.

Leaf area V/S cured weight plot⁻¹

Correlation observed positive and non-significant ($r = 0.3464^{NS}$) between the traits.

Leaf area V/S cured leaves kg⁻¹

Leaf area was negatively and non-significantly ($r = -0.3520^{NS}$) correlated with cured leaves kg⁻¹.

Leaf area V/S yield ha⁻¹

Positive and non-significant relationship ($r = -0.3464^{NS}$) showed in leaf area v/s yield ha⁻¹

Leaf area V/S nicotine

Leaf area was non-significantly and positively ($r = 0.1448^{NS}$) related with nicotine.

Leaf area V/S reducing sugars

It was negative and significant relationship ($r = -0.4583^*$) between leaf area and reducing sugars.

Green weight plot⁻¹ V/S green leaves kg⁻¹

Negative and highly significant relation observed ($r = -0.6656^{**}$) in studied traits.

Green weight plot⁻¹ V/S cured weight plot⁻¹

Positive but significant connection showed between the traits ($r = 0.4526^*$).

Green weight plot⁻¹ V/S cured leaves kg⁻¹

Negative and non-significant ($r = -0.1522^{NS}$) observed between green weight plot⁻¹ V/S cured weight plot⁻¹.

Green weight plot⁻¹ V/S yield ha⁻¹

Relationship in green weight plot⁻¹ V/S yield ha⁻¹ was (0.4526*) positive and significant.

Green weight plot⁻¹ V/S nicotine

Correlation coefficient (r) indicated (r= 0.5862**) positive but highly significant relationship in green weight plot⁻¹ with nicotine.

Green weight plot⁻¹ V/S reducing sugars

Favorable and highly significant (r = 0.13730.5749**) association observed between green weight plot⁻¹ with reducing sugars.

Green leaves kg⁻¹ V/S cured weight plot⁻¹

Correlation coefficient (r) between green leaves kg⁻¹ and cured weight plot⁻¹ revealed undesirable as well negative (r= -0.5027*)

Green leaves kg⁻¹ V/S cured leaves kg⁻¹

The association between green leaves kg⁻¹ with cured leaves kg⁻¹ was suitable and significant (r= 0.4581*) with each other.

Green leaves kg⁻¹ V/S yield ha⁻¹

The relationship was unfavorable and significant (r = -0.5027*) showed between parameters.

Green leaves kg⁻¹ V/S nicotine

Undesirable and non-significant association (r = -0.3582^{NS}) found in green leaves kg⁻¹ and Nicotine.

Green leaves kg⁻¹ V/S reducing sugars

Association between green leaves kg⁻¹ v/s reducing sugars illustrated negative and non-significant (r= -0.0738^{NS}) association.

Cured weight plot⁻¹ V/S cured leaves kg⁻¹

Negative but highly significant (r= -0.7439***) relationship between cured weight plot⁻¹ and cured leaves kg⁻¹ was observed.

Cured weight plot⁻¹ V/S yield ha⁻¹

Both the parameters were positively and high significantly correlated with each other (($r= 1.000^{***}$))

Cured weight plot⁻¹ V/S nicotine

Relationship showed positive and highly significant($r=0.5336^{**}$) between cured weight plot⁻¹ and nicotine.

Cured weight plot⁻¹ V/S reducing sugars

Relation between parameters negative and non-significant ($r=-0.2408^{NS}$) in parameters.

Cured leaves kg⁻¹ V/S yield ha⁻¹

Correlation observed negative but highly significant between cured leaves kg⁻¹ and yield ha⁻¹ ($r=-0.7439^{***}$)

Cured leaves kg⁻¹ V/S nicotine

Relationship illustrated negative and non-significant($r= -0.2227^{NS}$) between cured leaves kg⁻¹ v/s nicotine content.

Cured leaves kg⁻¹ V/S reducing sugars

Interrelation between parameters was positive and non-significant ($r= 0.348^{NS}$)

Yield ha⁻¹ V/S nicotine

Relation between yield ha⁻¹ and nicotine content was highly significant and positive ($r=0.5336^{**}$)

Yield ha⁻¹ V/S reducing sugars

The interrelation between the parameters was negative and undesirable ($r= -0.2408^{NS}$)

Nicotine V/S reducing sugars

The pair in traits was useful but non-significant ($r= 0.1280^{NS}$).

TITLE NO. 2: EVALUATION OF HOMOZYGOUS LINES OF FCV TOBACCO

The eight homozygous lines **E₁, E₂, E₃, E₄, E₅, E₆, E₇, E₈, K-399 and Spt.G.28** laid out at Tobacco Research Sub Station Mansehra in a randomized complete block design (RCBD) with three replications, Plant to plant and row to row distance maintained accordingly. A total of Nine (09) characters were recorded,

1. Days to 50% flowering
2. Plant height (cm)
3. Number of leaves plant⁻¹
4. Leaf area (cm²)
5. Green weight plot⁻¹ (Kg)
6. Green leaves kg⁻¹
7. Cured weight plot⁻¹ (Kg)
8. Cured leaves kg⁻¹
9. Cured yield ha⁻¹ (kg).

Data Analysis:

The values of mean squares were obtained according to Gomez and Gomez (1984) and the Pearson's correlation coefficients were calculated for each pair of traits by using Statistx 8.1 software.

Mean squares

Mean Squares from various quantitative traits indicated that all the genotypes were significantly different at (P<0.01) for 50% days to flowering, plant height (cm), leaf area (cm²), number of leaves plant⁻¹, green weight plot⁻¹, green leaves kg⁻¹, cured weight plot⁻¹, cured leaves kg⁻¹, and cured yield ha⁻¹ illustrated in **Table 1**.

TBALE 1 Mean squares for homozygous lines

Source of variation	Replications	Varieties	Error
Degrees of freedom	2	9	18
Days to 50 % flowering	2.533	405.793***	1.348
Plant height (cm)	2.569	507.123***	2.569
Leaf area (cm ²)	410.9	34797.5***	250.3
Numbers of leaves plant ⁻¹	2.4223	46.3720***	1.6168
Green weight plot ⁻¹ (Kg)	0.0191	11.0.462***	0.8340
Green leaves kg ⁻¹	80.627	247.011***	37.240
Cured weight plot ⁻¹ (Kg)	0.00188	0.14744***	0.00680
Cured leaves kg ⁻¹	397.10	1013.81**	275.971
Cured yield ha ⁻¹ (Kg)	6055	474144***	21873

Note: ***=Highly significant, ** significant at (p<0.01)

Table 2 Mean performance table for homozygous lines

Genotype	50% Days to flowering	Plant height (cm)	Leaf area (cm ²)	Number of Leaves Plant ⁻¹	Green weight plot ⁻¹ (kg)	Green leaves kg ⁻¹	Cured weight plot ⁻¹ (kg)	Cured leaves kg ⁻¹	Yield Ha ⁻¹ (kg)
E ₁	84.000 D	83.467 C	679.76 B	21.300 DE	9.4157 A	19.647 D	1.4420 AB	126.75 BCDE	2585.9 AB
E ₂	72.000 F	74.10 E	584.41 D	17.800 F	5.8807 CD	29.607 BCD	1.5001 A	118.84 CDE	2690.1 A

E ₃	59.667 I	77.867 D	660.16 B	20.567 DE	7.6733 B	21.460 CD	1.0717 EF	146.97 ABC	1921.8 EF
E ₄	90.667 B	91.567 B	573.69 D	26.867 B	4.5880 D	31.263 BC	1.0847 EF	130.21 ABCD	1945.1 EF
E ₅	76.000 E	97.000 A	466.54 F	17.367 F	2.9820 E	49.313 A	0.9223 G	154.37 AB	1654.0 G
E ₆	90.667 B	68.033 F	541.84 E	24.467 C	7.0420 BC	22.447 CD	1.5407 A	100.07 E	2762.9 A
E ₇	93.667 A	98.000 A	386.92 G	29.867 A	7.0420 BC	19.643 D	1.3537 BC	114.28 DE	2427.5 BC
E ₈	87.000 C	56.533 G	631.83 C	20.200 E	6.0573 CD	26.473 BCD	0.9827 FG	157.13 A	1762.2 FG
E ₉	70.000 G	81.000 C	743.17 A	22.467 CD	5.6000 CD	29.503 BCD	1.2460 CD	125.41 CDE	2234.4 CD
E ₁₀	67.667 H	74.633 E	675.39 B	24.233 C	4.7593 D	35.630 B	1.1280 DE	142.29 ABCD	2022.8 DE
LSD (P>0.05)	1.9917	2.7495	27.138	2.1812	1.5665	10.468	0.1415	28.456	253.70

Means followed by different letters in each rows is significantly different at P< 0.05 level of probability followed by Duncan's multiple range test (DMRT).

Mean performance

Days to 50% flowering

More days to flowering (**93.667**) days were taken by genotype **E₇** and less number of days to flowering (**67.667**) days were taken by genotype **E₁₀**. (**Table 2**)

Plant height (cm)

Taller plants were found (**98.00**) in genotypes **E₇** and dwarf plants (**56.533**) found in genotype **E₈**. (**Table 2**)

Leaf area (cm²)

Large leaf area measured (**743.17 cm²**) in genotype **E₉** and small leaf area measured (**386.92 cm²**) in candidate genotype **E₇**. (**Table 2**)

Number of leaves plant⁻¹

Higher numbers of leaves plant⁻¹ (29.867) were seen in line **E7** and lesser number (**17.800**) of leaves per plant seen in **E5**. (Table 2)

Green weight plot⁻¹ (Kg)

Higher green weight plot weighed (**9.4157 kg**) in genotype **E1** and minimum green weight plot⁻¹ weighed (**2.9820 kg**) in genotype **E5**. (Table 2)

Green leaves kg⁻¹

Maximum green leaves kg⁻¹ were counted (**49.313**) in hybrid **E5** and minimum green leaves kg⁻¹ were counted (**19.643**) in **E7**. (Table 2)

Cured weight plot⁻¹ (Kg)

High cured weight plot⁻¹ weighed (**1.5407** and **1.5001 Kg**) in genotypes **E6** and **E2** respectively and low green weight plot⁻¹ weighed (**0.9223 Kg**) in **E5**. (Table 2)

Cured leaves kg⁻¹

Maximum numbers of cured leaves kg⁻¹ counted (**157.13**) in **E8** and minimum number of leaves kg⁻¹ were counted (**100.07**) in hybrid **E6**. (Table 2)

Cured yield ha⁻¹ (kg)

Maximum cured yield ha⁻¹ weighed (**2762.9** and **2690.1 kg**) in genotype **E6** and **E2** respectively and minimum cured yield ha⁻¹ weighed (**1654.0 kg**) in genotype **E5**. (Table 2)

Table 3 Correlation coefficient

Characters	Plant height	Days to 50% flowering	Leaf area	Leaves plant ⁻¹	Green weight plot ⁻¹	Green leaves kg ⁻¹	Cured weight plot ⁻¹	Cured leaves kg ⁻¹
Days to flowering	0.1237 ^{NS}							
Leaf area	-0.5050**	-0.5490**						
Leaves plant ⁻¹	0.3103 ^{NS}	0.5219**	-0.3070 ^{NS}					
Green weight plot ⁻¹	-0.0945 ^{NS}	0.1905 ^{NS}	0.0800 ^{NS}	0.2312 ^{NS}				
Green leaves kg ⁻¹	0.2185 ^{NS}	-0.2109 ^{NS}	-0.1268 ^{NS}	-0.3475*	-0.8463**			
Cured weight plot ⁻¹	-0.0886 ^{NS}	0.2458 ^{NS}	-0.0498 ^{NS}	0.1987 ^{NS}	0.5586 **	-0.4458**		

Cured leaves kg ⁻¹	-0.0597 ^{NS}	-0.3223 ^{NS}	0.1668 ^{NS}	-0.4047*	-0.3678*	0.5372**	-0.6946***	
Yield ha ⁻¹	-0.0886 ^{NS}	0.2458 ^{NS}	-0.0498 ^{NS}	0.1987 ^{NS}	0.5586 **	0.4457**	1.000***	-0.6946***

Note: **** = highly significant; ** = highly significant at (1%) probability level; * = significant at (5%) probability level; ^{NS} = Non Significant

DESCRIPTION OF CORRELATION CO-EFFICIENT

Plant height V/S days to 50% flowering

The relationship indicated positive but non-significant correlation ($r = 0.1237^{NS}$) with 50% days to Flowering.

Plant height V/S leaf area

Negative and highly significant relationship ($r = -0.5050^{**}$) was observed between plant height with leaf area.

Plant height V/S leaves plant⁻¹

Relationship between days to plant height with leaves plant⁻¹ ($r = 0.3103^{NS}$) was found desirable and non-significant.

Plant height V/S green weight plot⁻¹

Inter-relationship indicates negative and non-significant ($r = -0.0945^{NS}$) correlation between plant height with green weight plot⁻¹.

Plant height V/S green leaves kg⁻¹

Interconnection between plant height with green leaves Kg⁻¹ was observed positive but insignificant ($r = 0.2185^{NS}$)

Plant height V/S cured weight plot⁻¹

Negative and non-significant ($r = -0.0886^{NS}$) relationship between plant height and cured weight plot⁻¹ was observed.

Plant height V/S cured leaves kg⁻¹

Positive but not important relation ($r = 0.3769^{NS}$) between Plant height and cured leaves Kg⁻¹ was recorded.

Plant height V/S yield ha⁻¹

Negative and non-important connection ($r = -0.0886^{NS}$) between plant height and yield ha⁻¹ resulted.

Days to 50% flowering V/S leaf area

The association between 50% days to flowering with leaf area was unsuitable and highly significant ($r = -0.5490^{**}$) with each other.

Days to 50% flowering V/S leaves plant⁻¹

Relationship revealed positive and highly significant ($r = 0.5219^{**}$) association between both the traits.

Days to 50% flowering V/S green weight plot⁻¹

Association suggested positive and non-significant relation ($r = 0.1905^{NS}$) between days to 50% flowering and green weight plot⁻¹.

Days to 50% flowering V/S green leaves kg⁻¹

There was insignificant and negative association ($r = -0.2109^{NS}$) between days to 50% flowering and green leaves kg⁻¹.

Days to 50% flowering V/S cured weight plot⁻¹

Relationship illustrated positive but negligible relation ($r = 0.2458^{NS}$) between studied traits.

Days to 50% flowering V/S cured leaves kg⁻¹

There was negative but insignificant association ($r = -0.3223^{NS}$) found between the parameters.

Days to 50% flowering V/S cured leaves Kg⁻¹

Interrelationship between days to 50% flowering V/S cured leaves Kg⁻¹ was positive but ignorable ($r = 0.2458^{NS}$).

Days to 50% flowering V/S yield ha⁻¹

The correlation between days to 50% flowering v/s Yield ha⁻¹ resulted unfavorable as well insignificant (-0.0940^{NS}) relationship.

Leaf area V/S leaves plant⁻¹

Undesirable and non-significant association ($r = -0.3070^{NS}$) found between leaf area number of leaves plant⁻¹

Leaf area V/S green weight plot⁻¹

Correlation coefficient (r) between leaf area and green weight plot⁻¹ revealed undesirable as well positive ($r = 0.0800^{NS}$)

Leaf area V/S green leaves kg⁻¹

Association between leaf area v/s green leaves kg⁻¹ illustrated negative and non-significant ($r = -0.1268^{NS}$) association.

Leaf area V/S cured leaves plot⁻¹

The relationship was unfavorable and non-significant ($r = -0.0498^{NS}$) showed between parameters.

Leaf area V/S cured leaves kg⁻¹

Positive but not important relationship ($r = 0.0166^{NS}$) observed between leaf area and cured leaves kg⁻¹

Leaf area V/S yield ha⁻¹

The interrelationship ($r = -0.0498^{NS}$) positive and non-significant between leaf area and yield ha⁻¹

Leaves plant⁻¹ V/S green weight plot⁻¹

Undesirable and non-significant association ($r = 0.2312^{NS}$) found in leaves plant⁻¹ and green weight plot⁻¹.

Leaves plant⁻¹ V/S green leaves kg⁻¹

Correlation coefficient (r) indicated ($r = -0.3475^*$) negative but significant in Leaves plant⁻¹ green leaves kg⁻¹.

Leaves plant⁻¹ V/S cured weight plot⁻¹

The association indicated pleasant but insignificant ($r = 0.1987^{NS}$) relationship between Leaves Plant⁻¹ V/S cured weight plot⁻¹.

Leaves plant⁻¹ V/S cured leaves kg⁻¹

Leaves plant⁻¹ and cured leaves kg⁻¹ relationship revealed negative and significant ($r = -0.4047^*$).

Leaves plant⁻¹ V/S yield ha⁻¹

Favorable but neglect able ($r = 0.1987^{NS}$) association observed between leaves plant⁻¹ and yield Ha⁻¹.

Green weight plot⁻¹ V/S green leaves kg⁻¹

Relationship revealed negative and highly significant ($r = -0.8463^{**}$) relationship.

Green weight plot⁻¹ V/S cured weight plot⁻¹

Correlation observed positive and highly significant ($r = 0.5586^{**}$) between the traits.

Green weight plot⁻¹ V/S cured leaves kg⁻¹

Green weight plot⁻¹ was negatively and significantly ($r = -0.3678^*$) correlated with cured leaves kg⁻¹.

Green weight plot⁻¹ V/S yield ha⁻¹

Positive and non-significant relationship ($r = 0.5586^{**}$) showed in green weight plot⁻¹ v/s yield ha⁻¹

Green leaves kg⁻¹ V/S cured weight plot⁻¹

Green leaves kg⁻¹ was highly significant and negatively ($r = -0.4458^{**}$) related with cured weight plot⁻¹.

Green leaves kg⁻¹ V/S cured leaves kg⁻¹

It was positive and significant relationship ($r = 0.5372^{**}$) between green leaves kg⁻¹ and Cured leaves kg⁻¹.

Green leaves kg⁻¹ V/S yield ha⁻¹

Negative and highly significant relation observed ($r = -0.4457^{**}$) in studied traits.

Cured weight plot⁻¹ V/S cured leaves kg⁻¹

Negative but highly significant connection showed between the traits ($r = -0.6946^{***}$).

Cured weight plot⁻¹ V/S yield ha⁻¹

Positive and highly significant ($r = 1.000^{***}$) observed between cured weight plot⁻¹ V/S yield ha⁻¹.

Cured leaves kg⁻¹ V/S yield ha⁻¹

Relationship in cured leaves kg⁻¹ V/S yield ha⁻¹ was (r= -0.6946***) negative and highly significant.

B: AGRONOMY SECTION

TITLE NO. 1: DIFFERENT DATES OF TRANSPLANTING FCV TOBACCO NURSERY AT TRSS MANSEHRA

Material and Methods

The two genotypes namely *Speight G-28* and *K-399* were grown at Tobacco Research Sub Station Mansehra in a randomized complete block design (RCBD) with factorial arrangements and four replicates, Plant to plant and row to row distance maintained constant. The four sowing dates were scheduled for transplanting tobacco nurseries to main field, sowing dates were arranged as; DoT₁ (10th March), DoT₂ (20th March), DoT₃ (30th March) and DoT₄ (10th April). A total of eleven characters were recorded as fallows;

1. Days to 50% flowering
2. Plant height (cm)
3. Number of leaves plant⁻¹
4. Leaf area (cm²)
5. Green weight plot⁻¹ (kg)
6. Green leaves kg⁻¹
7. Cured weight plot⁻¹ (kg)
8. Cured leaves kg⁻¹
9. Cured yield ha⁻¹ (kg)
10. Reducing sugars %
11. Nicotine %

Data Analysis: The values of mean squares were obtained according to Gomez and Gomez (1984) using Statistx 8.1 software.

RESULTS: The obtained results are described as fallows;

Mean squares

The traits, such as days to 50 % flowering, plant height (cm), number of leaves plant⁻¹, leaf area (cm²), green weight plot⁻¹ (kg), green leaves kg⁻¹, cured weight plot⁻¹ (kg), cured leaves kg⁻¹, cured yield ha⁻¹ (kg), reducing sugars % and Nicotine % differed significantly for all the characters among the tested genotypes. The genotype × transplanting interactions were also significantly different for majority of the studied traits shown in **Table 1**.

Table 1 Mean squares of different traits of tobacco genotypes

Source of variances	Replications (r-3)	Genotypes (G) (g-1)	Transplanting Date (T) (t-3)	G x S interaction (g-1)*(t-3)	Error (25)
Days to 50% flowering	57.708	171.125*	180.458**	20.125^{NS}	29.518
Plant height (cm)	8.10	337.74***	2523.68***	357.05***	6.63
Number of leaves plant ⁻¹	1.099	17.258**	177.243***	30.389***	1.585
Leaf area (cm ²)	888	22888***	274779***	9055***	613
Green weight plot ⁻¹ (kg)	0.17728	0.00036^{NS}	8.52028***	3.52842**	0.54128
Green leaves kg ⁻¹	25.491	6.360^{NS}	135.861**	102.507*	22.710
Cured weight plot ⁻¹ (kg)	0.01094	0.10695***	0.58146***	0.08243***	0.00607
Cured leaves kg ⁻¹	359.38	801.26*	2231.56**	136.16^{NS}	185.92
Cured yield ha ⁻¹ (kg)	35188	343953***	1869935***	265074***	19521
Reducing sugars%	0.3845	19.5625***	12.3831***	2.8353***	0.0808
Nicotine%	0.01811	0.07508*	0.05180**	0.15904***	0.00968

*** (Highly Significant), ** (Significant at 1%), * (Significant at 5%), ^{NS} (Non-Significant)

MEAN PERFORMANCE

Table 2 Days to 50 % flowering

Transplanting date/ Genotypes	K-399	Speight G-28	Treatment average
10 th March (Normal transplanting)	82.750	88.250	85.5
20 th March (10 days late)	83.250	84.250	83.75
30 th March (20 days late)	75.000	78.500	76.75
10 th April (late transplanting)	72.000	80.500	76.25
Genotype average	78.25	82.87	
Source of Variation	LSD (P<0.05)		
Genotype	3.9947		
Transplanting Date	5.6493		
Genotype x Transplanting Date	7.9893		

From **Table 2** it is observed that, days to 50 % flowering on normal transplantation, the maximum days to 50 % flowering were taken by Speight G-28 (~88 days), while nearly 78.5 days were taken by 20 days late transplanting, however, the genotype K-399 nearly taken 83 and 72 days to 50 % flowering by second transplanting and late transplanting, respectively.

Table 3 Plant height (cm)

Transplanting date/ Genotypes	K-399	Speight G-28	Treatment average
10 th March (Normal transplanting)	77.20	102.70	89.95
20 th March (10 days late)	95.49	93.60	94.54
30 th March (20 days late)	70.77	76.85	73.81
10 th April (late transplanting)	57.20	53.50	55.35
Genotype average	75.16	81.66	
Source of Variation	LSD (P<0.05)		
Genotype	1.8936		
Transplanting Date	2.6780		
Genotype x Transplanting Date	3.7873		

In the normal transplanting the taller plants (102.7 cm) were measured in Speight G-28, while dwarf plants (53.50 cm) were measured in late sowing, whereas in the genotype K-399 taller plants (95.49 cm) were seen in 10 days late transplanting and shorter plants (57.2 cm) were recorded in late transplanting as shown in **Table 3**.

Table 4 Number of leaves plant⁻¹

Transplanting date/ Genotypes	K-399	Speight G-28	Treatment average
10 th March (Normal transplanting)	29.650	24.575	27.11
20 th March (10 days late)	25.050	27.725	26.38
30 th March (20 days late)	21.750	17.250	19.50
10 th April (late transplanting)	17.375	18.400	17.37
Genotype average	23.45	21.98	
Source of Variation	LSD (P<0.05)		
Genotype	0.925		
Transplanting Date	1.3091		
Genotype x Transplanting Date	1.8514		

A higher number of leaves plant⁻¹ (29.6 leaves) were counted in normal transplanting for the genotype K-399 and less leaves plant⁻¹ (17.4) counted in late transplanting. For the genotype Speight G-28, 27.72 leaves plant⁻¹ were recorded in ten days interval to normal transplanting and 17.25 leaves plant⁻¹ for late transplanting (**Table 4**).

Table 5 Leaf area (cm²)

Transplanting date/ Genotypes	K-399	Speight G-28	Treatment average
10 th March (Normal transplanting)	517.79	528.10	522.94
20 th March (10 days late)	613.37	763.14	688.22
30 th March (20 days late)	400.73	450.42	425.57
10 th April (late transplanting)	242.90	247.08	244.99
Genotype average	443.69	497.18	
Source of Variation	LSD (P<0.05)		
Genotype	18.201		
Transplanting Date	25.740		
Genotype x Transplanting Date	36.402		

A larger leaf area in 10 days late transplanting is measured for both the genotypes Speight G-28 (763.14 cm²) and K-399 (613.37 cm²), while smaller leaf area *i.e.* 242.9 and 247.8 cm² is measured for the genotypes K-399 and Speight G-28, respectively as detailed in **Table 5**.

Table 6 Green weight plot⁻¹ (kg)

Transplanting date/ Genotypes	K-399	Speight G-28	Treatment average
10 th March (Normal transplanting)	7.5788	7.2925	7.43
20 th March (10 days late)	8.6983	6.9505	7.82
30 th March (20 days late)	7.1120	8.2698	7.69
10 th April (late transplanting)	5.1622	6.0655	5.61
Genotype average	7.13	7.14	
Source of Variation	LSD (P<0.05)		
Genotype	0.5409		
Transplanting Date	0.7650		
Genotype x Transplanting Date	1.0819		

From **Table 6** a maximum green weight plot⁻¹ weighed for the genotype K-399 (8.7 Kg) in 10 days late transplanting, while minimum weight plot⁻¹ (5.16 Kg) was weighed in late transplanting. Similarly, for Speight G-28, 20 days late transplanting shown higher weight (8.26 Kg) and late transplanting weighed (6.06 Kg).

Table 7 Green leaves kg⁻¹

Transplanting date/ Genotypes	K-399	Speight G-28	Treatment average
10 th March (Normal transplanting)	25.755	29.018	27.38
20 th March (10 days late)	22.845	29.356	26.10
30 th March (20 days late)	30.507	26.567	28.53
10 th April (late transplanting)	40.040	30.639	35.33
Genotype average	29.78	28.89	
Source of Variation	LSD (P<0.05)		
Genotype	3.5038		
Transplanting Date	4.9552		
Genotype x Transplanting Date	7.0077		

From **Table 6** a maximum green leaves kg^{-1} (40.04) were counted for the genotype K-399 in 10 days late transplanting, while minimum (22.85) for late transplanting. Similarly, for Speight G-28, 30.63 and 29.01 green leaves kg^{-1} are counted for late transplanting and normal transplanting, respectively.

Table 8 Cured weight plot⁻¹ (kg)

Transplanting date/ Genotypes	K-399	Speight G-28	Treatment average
10 th March (Normal transplanting)	1.9175	2.0582	1.98
20 th March (10 days late)	2.1922	1.9183	2.05
30 th March (20 days late)	1.8220	1.7757	1.79
10 th April (late transplanting)	1.5953	1.3122	1.45
Genotype average	1.88	1.76	
Source of Variation	LSD (P<0.05)		
Genotype	0.0573		
Transplanting Date	0.0810		
Genotype x Transplanting Date	0.1146		

From **Table 8** a maximum cured weight plot⁻¹ (2.19 Kg) was recorded for K-399 for 10 days after normal transplanting, while minimum cured weight plot⁻¹ (1.59 Kg) is for late transplanting. Similarly, for Speight G-28 normal transplanting and late transplanting shown 2.05 and 1.31 Kg cured weight plot⁻¹, respectively.

Table 9 Cured leaves kg^{-1}

Transplanting date/ Genotypes	K-399	Speight G-28	Treatment average
10 th March (Normal transplanting)	101.5	100.31	100.90
20 th March (10 days late)	86.64	102.52	94.58
30 th March (20 days late)	115.48	124.41	119.94
10 th April (late transplanting)	122.44	138.91	130.675
Genotype average	106.51	116.53	
Source of Variation	LSD (P<0.05)		
Genotype	10.025		
Transplanting Date	14.178		
Genotype x Transplanting Date	20.051		

A higher cured leaves kg^{-1} is recorded for Speight G-28 (138.91) in late transplanting and lower (100.31) in normal transplanting, while for K-399 a maximum number of cured leaves kg^{-1} were counted (122.44) in late transplanting and minimum (86.64) for 10 days late transplanting as shown in **Table 9**.

Table 10 Cured yield ha⁻¹ (kg)

Transplanting date/ Genotypes	K-399	Speight G-28	Treatment average
10 th March (Normal transplanting)	3438.7	3691.1	3564.9
20 th March (10 days late)	3931.4	3440.0	3685.7
30 th March (20 days late)	3267.4	3184.5	3225.95
10 th April (late transplanting)	2860.8	2353.3	2607.05
Genotype average	3374.57	3167.22	
Source of Variation	LSD (P<0.05)		
Genotype	102.73		
Transplanting Date	145.28		
Genotype x Transplanting Date	205.45		

From the **Table 10**, K-399 weighed (3931.4 Kg) maximum cured yield ha⁻¹ for 10 days late transplanting, while last transplanting exhibited lower (2860.8 Kg) cured yield ha⁻¹, whereas Speight G-28 with normal transplanting proved high yield (3691.1 Kg) and very low (2353.3 Kg) for late transplanting.

Table 11 Reducing sugars %

Transplanting date/ Genotypes	K-399	Speight G-28	Treatment average
10 th March (Normal transplanting)	9.458	12.578	11.01
20 th March (10 days late)	12.568	13.688	13.12
30 th March (20 days late)	12.428	14.148	13.28
10 th April (late transplanting)	10.948	11.243	11.09
Genotype average	11.35	12.91	
Source of Variation	LSD (P<0.05)		
Genotype	0.2090		
Transplanting Date	0.2955		
Genotype x Transplanting Date	0.4180		

The genotype Speight G-28 resulted in a higher reducing sugars % (14.14 %) for 20 days late transplanting and lower for late transplanting (11.24 %), on the other hands the genotype K-399 resulted 12.56 and 9.45 % reducing sugar for ten days late transplanting and normal transplanting, respectively (**Table 11**).

Table 12 Nicotine content %

Transplanting date/ Genotypes	K-399	Speight G-28	Treatment average
10 th March (Normal transplanting)	2.4325	2.9050	2.66
20 th March (10 days late)	2.7325	2.8500	2.79
30 th March (20 days late)	2.8625	2.8575	2.86
10 th April (late transplanting)	2.8425	2.6450	2.74
Genotype average	2.71	2.81	
Source of Variation	LSD (P<0.05)		
Genotype	0.0723		
Transplanting Date	0.1023		
Genotype x Transplanting Date	0.1447		

From **Table 12**, normal transplanting of the genotype Speight G-28 shown a higher (2.9 %) nicotine content and lower (2.6 %) for late transplanting. Whereas for K-399, 20 days late transplanting shown a higher nicotine content (2.9%) and lower (2.7 %) for normal transplanting.

III. TOBACCO MODEL FARM (TMF), BUNER

TITLE NO. 1: FLUE CURED VIRGINIA VARIETAL EVALUATION TRIAL

INTRODUCTION:

Methodology

These exotic genotypes namely Spt-G.28, K-399, CSC-447 and PVH-2310 the experiment was laid out at Tobacco Model Farm Ambela Buner, in a randomized complete block design (RCBD) with three replications, Plant to plant and row to row distance maintained as recommended. Following characters were recorded,

- Plant height (cm)
- Number of Leaves plant⁻¹
- Leaf area (cm²)
- Green leaves Kg⁻¹
- Cured leaves kg⁻¹
- Cured weight plot⁻¹ (Kg)
- Yield ha⁻¹ (Kg)

Data Analysis

The values of mean squares were obtained according to Gomez and Gomez (1984) and LSD ($P>0.05$) for traits by using Statistx 8.1 software.

Mean Squares

The traits, such as plant height (cm), number of leaves plant⁻¹, leaf area (cm²), (kg), green leaves kg⁻¹, cured weight plot⁻¹ (kg), cured leaves kg⁻¹, cured yield ha⁻¹ (kg), differed significantly for all the characters among the tested genotypes. Shown in **Table 1**.

Table 1 Mean Squares of studied characters

[PH]= Plant height, [LP]= leaves plant⁻¹, [LA]= leaf area, [GLK]= green leaves kg⁻¹, [CLK] cured leaves kg⁻¹, [CWP]= cured weight plot⁻¹, [YH]= yield ha⁻¹.

SoV	DF	PH	LP	LA	GLK	CLK	CWP	YH
Rep	2	7.00	3.7658	1458	11.083	7.583	0.00065	2076
Variety	3	133.00***	43.3311***	2231.22***	34.0833***	168.750**	0.13258***	426376***
Error	6	2.00	1.2803	21.14	1.0833	7.250	0.00061	1955
Total	11							

***highly significant, ** significant at $P>0.01$

Table 2 Parameter wise mean performance of tobacco genotypes

Genotype/ Characters	Plant height (cm)	Number of leaves plant ⁻¹	Leaf area (cm ²)	Green leaves kg ⁻¹	Cured leaves kg ⁻¹	Cured weight plot ⁻¹ (kg)	Yield ha ⁻¹ (kg)
CSC-447	106A	21.300B	1012A	41.33B	105.00B	1.45A	2600.3A
PVH-2310	101B	17.800 C	990B	37.33C	100.00BC	1.26B	2253.6B
K-399	104A	20.567B	978C	39.667B	98.33C	1.036C	1859.1C
Speight- G-28	91C	26.867A	948D	45.33A	115.00A	0.997C	1788.5C

Mean performance of agronomic traits

Plant height (cm)

The taller plants measured (**106 cm**) in genotypes **CSC-447** and dwarf (**91 cm**) plants found in genotype **Speight-G-28** as described in shown in **Table 02**.

Number of leaves plant⁻¹

Higher number of leaves plant⁻¹ (**26.267**) was counted in **Speight G-28** and lesser number (**17.800**) of leaves plant⁻¹ seen in **PVH-2310** shown in **Table 2**.

Leaf Area (cm⁻²)

Large leaf area measured (**1012.00 cm⁻²**) in genotype **CSC-447** and small leaf area measured (**948.00 cm⁻²**) in genotype **Speight g-28**, (**Table 2**).

Green Leaves Kg⁻¹

As shown in **Table 2** the maximum green leaves kg⁻¹ were counted (**45**) in cultivated genotype **Speight G -28** and minimum green leaves kg⁻¹ were counted (**37**) in **PVH-2310**.

Cured leaves kg⁻¹

A maximum number of cured leaves kg⁻¹ counted (**115**) in **Speight G 28** and minimum number of leaves kg⁻¹ were counted (**98**) in genotype **K-399** as detailed **Table 2**.

Cured weight plot⁻¹ (kg)

The higher cured weight plot⁻¹ weighed (**1.45 Kg**) in genotypes **CSC-447** and low green weight plot⁻¹ weighed (**0.997 Kg**) in **Speight G-28**. (**Table 02**).

Cured yield ha⁻¹ (Kg)

Variety	Plant height (cm)	Number of leaves plant ⁻¹	Leaf area (cm ²)	Green leaves kg ⁻¹	Green weight plot ⁻¹ (kg)	Cured leaves kg ⁻¹	Cured weight plot ⁻¹ (kg)	Yield ha ⁻¹ (kg)
Rustica-13	37	10	174	102	3.44	550	0.81	1934
R-Hazro	40	9	152	129	2.47	519	0.66	1582
R-Bubak	39	9	162	183	2.82	672	0.70	1658
Rustica-19	33	10	117	109	2.74	521	0.72	1709
Rustica-14	39	10	173	104	3.46	512	1.005	2412

The optimum cured yield ha⁻¹ weighed (2600.3 Kg) in genotype **CSC-447** and minimum cured yield ha⁻¹ weighed (1788Kg) in genotype **Speight G 28** shown in **Table 2**

TITLE NO. 2: RUSTICA VARIETAL TRIAL AT TOBACCO MODEL FARM AMBELA BUNER

This trail was carried out by Botany Section from TRS Mardan

TITLE NO. 3: CUTWORM CONTROL TRIAL

Cutworm is among the major insect pest of Tobacco crop. Cutworm is the nocturnal insect and cut the whole Rustica Tobacco plant from basal portion. If not controlled eats up whole the plants and leads to 100% failure of the plant. The efficacy of Jatara and Alpha cypermetrine for better control of Cutworm was studied.

The trial was laid out in **RCBD** system, with three repeats with inter and intra line plant space 45 cm and 30 cm with all variety Rustica-14. All other recommended cultural operations of Rustica tobacco were followed.

Collected the data and after careful statistical analysis shows that the insecticide Alpha cypermetrine performed the best result in respect of control of cutworm followed by Jatara.

This was the Second year of the trial and will be repeated next year to confirm the result.

IV. TOBACCO RESEARCH SUB-STATION (TRSS), OKARA

A- AGRONOMY SECTION

TITLE NO. 1: DAC VARIETAL TRIAL

Material and Method

An experiment conducted in the Randomized complete block design (RCBD) with 07 treatments and 03 replications at the Tobacco Research Sub-station Okara, to find out the best performing DAC variety. The varietal trial conducted to study the different DAC varieties with respect to our specific climatic conditions and commercial requirements. However, secondary objective is to collect the data for maintain the high yielding germplasm varieties for the future breeding purpose. Urea, DAP & SOP were used as source of nutrients for Nitrogen, phosphorus &

potash application as basal dose. All recommended cultural practices and plant protection measures adopted.

The treatments were as under:

Treatments

T ₁ :	GALPAO
T ₂ :	MA-2
T ₃ :	OK-1
T ₄ :	OK-2
T ₅ :	OK-3
T ₆ :	OK-4
T ₇ :	OK-5

Sources:

a)	DAC varieties
b)	UREA
c)	DAP
d)	SOP

Parameters studied:

1. Plant height (cm)
2. Date of flowering
3. Number of leaves plant⁻¹
4. Green weight plot⁻¹ (kg)
5. Cured weight plot⁻¹ (kg)
6. Yield hectare⁻¹ (kg)

Results and discussion: Trial No. 01

Varieties	Plant Height (cm)	Days of Flowering	Number of Leaves plant ⁻¹	Green weight Plot ⁻¹ (kg)	Cured weight Plot ⁻¹ (kg)	Yield Hectare ⁻¹ (kg)
GALPAO	203.87 A	79.7 E	34.0 A	64.3 A	10.95 A	3674.7 A
MA-2	193.43 B	84.7 D	30.3 B	61.00 B	9.75 B	3442.0 B
OK-1	167.27 C	89 C	27.3 C	53.76 C	8.4 C	2958.7 C
OK-2	155.83 D	89.33 C	26.6 CD	50.23 D	7.897 C	2643.7 D
OK-3	146.50 E	90.7 B	25.7 CDE	48.55 E	7.3 D	2400.3 E
OK-4	142.67 F	92 A	25.0 DE	43.43 F	6.9 D	2105.3 F
OK-5	135.00 G	92.3 A	24.3 E	41.7 G	6.22 E	1987.3 G

Table 01: Mean performance of Plant Height cm (PH), Leaves plant⁻¹(LPP), Leaf Area cm² (LA), Yield per Hectare (YLDH) of DAC Tobacco in TRSS Okara.

*Means followed by different letters in the respective column are significantly different at 5% and 1% probability level according to LSD test.

Results and discussion

1. Plant Height (cm):

The highest value of plant height obtained 203.87 cm in Galpao variety and the lowest plant height obtained 135.00 cm in the OK-5 variety.

2. Days of flowering:

Maximum number of days of flowering were taken by 92.3 in OK-5 variety and the lowest number of days took to flowering by Galpao having 79.7 days.

3. Number of Leaves plant⁻¹

The highest number of leaves plant⁻¹ obtained 34 in Galpao variety and the lowest numbers of leaves plant⁻¹ obtained 24.3 in the OK-5 variety.

4. Green weight plot⁻¹ (kg)

The highest value of green weight plot⁻¹ in kg observed in Galpao variety having 64.3 kg and the lowest value obtained in Ok-5 variety value 41.7 kg

5. Cured weight plot⁻¹ (kg)

The highest value of cured weight plot⁻¹ in kg observed in Galpao variety 10.95 kg while the lowest value obtained in Ok-5 variety 6.22 kg.

6. Yield hectare⁻¹ (kg)

The highest yield hectare⁻¹ was observed in Galpao variety having 3647.7 kg and the lowest value observed in Ok-5 variety 1987.3 kg.

Data Analysis

The values of mean squares were obtained according to Gomez and Gomez (1984) by using Statistix (8.1) software.

Mean Squares

Means squares of varieties from ANOVA were carried out for 6 parameters were recorded which affect the tobacco yield directly or indirectly. Mean Squares displayed that all the characters including: Plant height (cm), days of flowering, numbers of leaves plant⁻¹, green weight plot⁻¹ (kg), cured weight plot⁻¹ (kg), yield hectare⁻¹ (kg) were exhibited highly significant differences at (P<0.01) for all the examined varieties showed in Table 02.

Table: 02- Means Squares of Different Characters of DAC Varieties

Means Squares of Different Characters of DAC Varieties			
Source of variation	Replications	Treatments	Error
Degrees of freedom	2	6	12
Plant Height (cm)	0.39	2066.86***	1.55
Date Of Flowering 50%	0.33	62.41***	0.56
No. Of leaves/plant	0.33	35.269***	1.056
Green wt/plot (kg)	0.334	215.637***	0.784
Cured wt/plot (kg)	0.01023	8.167***	0.08
Yield/Ha (kg)	947	1254019***	1375

Note: ***=Highly Significant (P<0.01)

TITLE NO. 2: DESI (HUQQA) VARIETAL TRIAL

Material and Methods

Experiment conducted in the Randomized complete block design (RCBD) with 06 treatments and 03 replications at the Tobacco Research Sub-station Okara, to find out the top performing Desi (Huqqa) variety. The varietal trial conducted to study the different Desi Huqqa varieties and lines with high yielding variety with desirable quality characteristics. Urea, DAP & SOP were used as source of nutrients for Nitrogen, phosphorus & potash application as basal dose. All recommended cultural practices and plant protection measures were adopted.

Treatments

T ₁ :	DHAPRI
T ₂ :	SP-1
T ₃ :	OKH-2013
T ₄ :	OKH-2003
T ₅ :	OKH-2011
T ₆ :	OKH-2029

Sources:

a)	DAC varieties
b)	UREA
c)	DAP
d)	SOP

Table 03: Mean performance of plant height (cm), leaves plant⁻¹, leaf area (cm²), yield hectare⁻¹ of DAC Tobacco in TRSS Okara.

Varieties	Plant Height (cm)	Days of Flowering	Numbers of Leaves plant ⁻¹	Green weight Plot ⁻¹ (kg)	Cured weight Plot ⁻¹ (kg)	Yield Ha ⁻¹ (kg)
Daphri	89.83 B	56.33 C	13.33 A	6.90 A	1.18 A	3053.3 A
SP-1	92.33 A	53.33 D	12.77 A	5.93 B	0.93 B	2678.3 B
OKH-2013	81.83 D	59.33 B	10.33 B	5.10 C	0.84 BC	2630.0 B
OKH-2003	85.00 C	58.00 BC	9.00 C	4.77 D	0.77 CD	2028.0 C
OKH-2011	78.75 E	63.00 A	8.33 C	4.37 E	0.72 D	1749.3 D
OKH-2029	75.63 F	60.00 B	7.00 D	4.05 F	0.59 E	1570.7 E

*Means followed by different letters in the respective column are significantly different at 5% and 1% probability level according to LSD test.

Parameters studied:

1. Plant height (cm)
2. Days of Flowering
3. Number of leaves per plant
4. Cured weight per plot
5. Cured leaves per plot
6. Yield per hectare (kg)

Results and discussion:

Plant Height (cm)

The highest value of plant height obtained (92.33 cm) in SP-1 variety and the lowest plant height measured (75.63 cm) in the OKH-2029 variety.

Days of flowering

Maximum number of days of flowering taken (63.0 days) by OKH-2011 variety and the minimum number of days took to flowering by SP-1 (53.33 days).

Number of leaves plant⁻¹

Highest number of leaves plant⁻¹ counted (**13.33**) in genotype Daphri and the lowest leaves plant⁻¹ was counted (**7.00**) in genotype OKH-2029.

Green weight plot⁻¹ (kg)

The highest value of green weight plot⁻¹ weighed in genotype Daphri (**6.90 kg**) and the lowest value of green weight plot⁻¹ weighed in genotype OKH-2029 (**4.05 kg**).

Cured weight plot⁻¹ (kg)

The highest value of cured weight plot⁻¹ weighed in genotype Daphri (**1.18 kg**) and the lowest cured weight plot⁻¹ produced by genotype OKH-2029 (**0.59 kg**).

Yield hectare⁻¹ (kg)

The highest yield hectare⁻¹ produced by genotype Daphri (**3053.3 kg**) and the lowest (**1570.7 kg**) yield hectare⁻¹ produced by genotype OKH-2029.

Data Analysis

The values of mean squares were obtained according to Gomez and Gomez (1984) by using Statistix (8.1) software.

Mean Squares

Mean squares from ANOVA carried out for 6 parameters which affect the tobacco yield directly or indirectly. Mean Squares displayed that all the characters including: Plant height (cm), days of flowering, number of leaves plant⁻¹, green weight plot⁻¹ (kg), cured weight plot⁻¹ (kg), yield hectare⁻¹ (kg) exhibited highly significant differences at (P<0.01) for all the examined characters showed in Table 04.

Table 04: Means Squares of Different Characters of HUQQA Varieties

Means Squares of Different Characters of HUQQA Varieties			
Source of variation	Replications	Treatments	Error
Degree of freedom	2	5	10
Plant Height (cm)	0.19	124***	0.51
D.O.Flowering 50%	2.1667	32.8***	1.3667
No. Of leaves/plant	0.2222	18.6222***	0.4222
Green wt/plot (kg)	0.01257	3.43239***	0.0179
Cured wt/plot (kg)	0.00716	0.12043***	0.00411
Yield/Ha (kg)	2002	1036399***	2167

Note: ***=Highly Significant (P<0.01)

TITLE NO. 3: BUDWORM CONTROL TRIAL AT TRSS OKARA 2020-21

An experiment conducted at TRSS Okaras to evaluate the efficacy of different insecticides against Budworm insect on DAC Tobacco. Five different insecticides were used at their

recommended doses. The treatments were arranged in randomized complete block design (RCBD) with three replications. The detail of insecticides applied is as under.

Sr. No.	Insecticide	Dose
1	Coragen	60 ml/acre
2	Belt	50 ml/acre
3	Lufenuron	200 ml/acre
4	Bifenthrin	250 ml/acre
5	Acephate	330 g/acre
6	Control	----

The statistical data of the Budworm Control Trial shows that all the insecticides gave control against the Budworm according to their efficacy as compared to the control where no insecticide was applied. The best control was recorded in T₂ where Belt insecticide was applied as shown in the table of Means and the mean value recorded after the spray was only 0.67. Second most effective control was recorded by the use of Coragen (T₁) followed by Acephate (T₅) with the mean values recorded were 1.00 and 2.33 respectively. The highest attack was observed in the treatment (T₆) where no insecticide was applied as the mean value was 11.67, while Leufenoran (T₃) and Bifenthrin (T₄) showed comparatively less control as compared to the other treatments and the mean values recorded after the spray were 3.67 and 6.33, respectively.

Data analysis:

The values of mean squares were obtained according to Gomez and Gomez (1984) by using Statistix (8.1) software.

Mean square value:

Mean square value for the above said trial was carried by calculating number of affected plants after the spray and by finding out their percentage. The results showed highly significant differences by all the treatments.

Table: 01 - Mean square values of Budworm's Population percentage

Source of variation	Replications	Treatments	Error
Degree of freedom	2	5	10
Population %	0.0038	52.0774***	0.0308

Table: 02 - LSD All-Pair wise Comparisons Test of Data for Treatments

Treatments	Mean	Homogeneous Groups
T ₆	11.67	A
T ₄	6.33	B
T ₃	3.67	BC
T ₅	2.33	C
T ₁	1.00	C
T ₂	0.67	C

Note: Means followed by different letters in the respective columns are highly significantly different at 1% probability level according to the LSD Test.

TITLE NO. 4: CUTWORM CONTROL TRIAL AT TRSS OKARA 2020-21

Material and Methods

An experiment conducted at TRSS Okara to evaluate the efficacy of different insecticides against Cutworm insect on DAC Tobacco. Five insecticides were used at their recommended doses. The treatments were arranged in randomized complete block design (RCBD) with three replications. The detail of insecticides applied is as under.

Sr. No.	Insecticide	Dose
1	Coragen	60 ml/acre
2	Belt	25 ml/acre
3	Lufenuron	200 ml/acre
4	Bifenthrin	250 ml/acre
5	Acephate	330 g/acre
6	Control	-----

The statistical data of the cutworm control trial shows that all insecticides gave control against the cutworm insect according to their efficacy as compared to the control where no insecticide was applied. The best control was recorded in T₂ where Belt insecticide was applied as shown in the table and 0.33 mean value was recorded after the spray. Second most effective control was recorded by the use of Coragen (T₁) followed by Bifenthrin (T₄) with the mean values recorded were 0.67 and 1.00 percent respectively, while Lufenuron (T₃) showed comparatively less control as compared to the other insecticides and the mean value recorded after the spray was 4.67. The highest attack was observed in the treatment (T₆) where no insecticide was applied as the mean value recorded was 7.00.

Data analysis

The values of mean squares were obtained according to Gomez and Gomez (1984) by using Statistix (8.1) software.

Mean squares

Mean square value for the above said trial was carried by calculating number of affected plants after the spray and by finding out their percentage. The results showed highly significant differences by all the treatments.

Table: 01 - Mean square values of Cutworm's Population percentage

Source of variation	Replications	Treatments	Error
Degree of freedom	2	5	10
Population %	0.0368	22.0021***	0.0583

Table: 02 - LSD All-Pair wise Comparisons Test of Data for Treatments

Treatments	Mean	Homogeneous Groups
T ₆	7.00	A
T ₃	4.67	B
T ₅	1.33	C
T ₄	1.00	C
T ₁	0.67	C
T ₂	0.33	C

Note: Means followed by different letters in the respective columns are significantly different at 1% probability level according to the LSD Test.

TITLE NO. 5: APHIDS CONTROL TRIAL AT TRSS OKARA 2020-21

Material and Methodology

An experiment conducted at TRSS Okara to evaluate the efficacy of different insecticides against the Aphid insect on DAC Tobacco. Five insecticides were used at their recommended doses. The treatments were arranged in randomized complete block design (RCBD) with three replications. The detail of insecticides applied is as under.

Sr. No.	Name of Insecticide	Dose
T ₁	Clothianidin	150 ml/acre
T ₂	Nitenpyram	50 g/acre
T ₃	Danadim	250 ml/acre
T ₄	Imidacloprid	250 g/acre
T ₅	Acetamiprid	330 g/acre
T ₆	Control	-----

The statistical data of the aphid control trial shows that all insecticides gave control against aphid populations according to their efficacy as compared to the control where no insecticide was applied. The best control was recorded by the use of treatments T₄ and T₁ where Imidacloprid and Clothianidin insecticides were applied as shown in the table and the mean values recorded after the spray were only 1.00 and 1.33 respectively. Danadim (T₃) and Acetamiprid (T₅) also gave satisfactory results in controlling the aphids and mean values recorded were 2.00 and 2.33 respectively after the spray. Among the applied insecticides, least control was recorded by the use of Nitenpyram (T₂) and the mean value recorded was 13.33. The highest aphid infestation was observed in the control treatment (T₆) where no insecticide was applied and the mean value was 17.33.

Data analysis:

The values of mean squares were obtained according to Gomez and Gomez (1984) by using Statistix (8.1) software.

Mean square value:

Mean square value for the above said trial was carried by calculating number of affected plants after the spray and by finding out their percentage. The results showed highly significant differences by all the treatments.

Table: 01 - Mean square values of Aphids' Population percentage

Source of variation	Replications	Treatments	Error
Degree of freedom	2	5	10
Population %	0.023	154.927***	0.164

Table: 02 -LSD All-Pair wise Comparisons Test of Data for Treatments

Treatments	Mean	Homogeneous Groups
T ₆	17.33	A
T ₂	13.33	B
T ₅	2.33	C
T ₃	2.00	C
T ₁	1.33	C
T ₄	1.00	C

Note: Means followed by different letters in the respective columns are significantly different at 1% probability level according to the LSD Test.

V. TOBACCO RESEARCH SUB-STATION (TRSS) KUNJAH (GUJRAT)

TITLE NO. 1: SOURCE BASED FERTILIZER APPLICATION (PHOSPHORUS & NITROGEN) TRIAL 2021

Material and methodology

Research conducted to check the efficacy of different combinations of Nitrogen and phosphorus fertilizers applied with recommended dozes @ 100: 80: 80 of Nitrogen, phosphorus and potash respectively. The trail on the DAC crop (Gulpao variety) was conducted at Tobacco Research Sub-Station Kunjah, Gujrat. Plants were planted while maintaining plant to plant and row to row distance of 60cm and 90cm respectively. Following 9 treatments were applied while using RCBD at the recommended dozes and 3 replications/blocks of each treatment were laid to cross check the effectiveness of the treatment.

S. No.	TREATMENTS
1	Control (Di-Ammonium Phosphate + Urea)
2	Di-Ammonium Phosphate + CAN
3	Di-Ammonium Phosphate + Ammonium Sulphate
4	Nitro phosphate + Urea
5	Nitro phosphate + CAN
6	Nitro phosphate + Ammonium Sulphate
7	Single Super Phosphate + Urea
8	Single Super Phosphate + CAN
9	Single Super Phosphate + Ammonium Sulphate

Recommended doses of treatment fertilizers were applied and data was collected at maturity of crop.

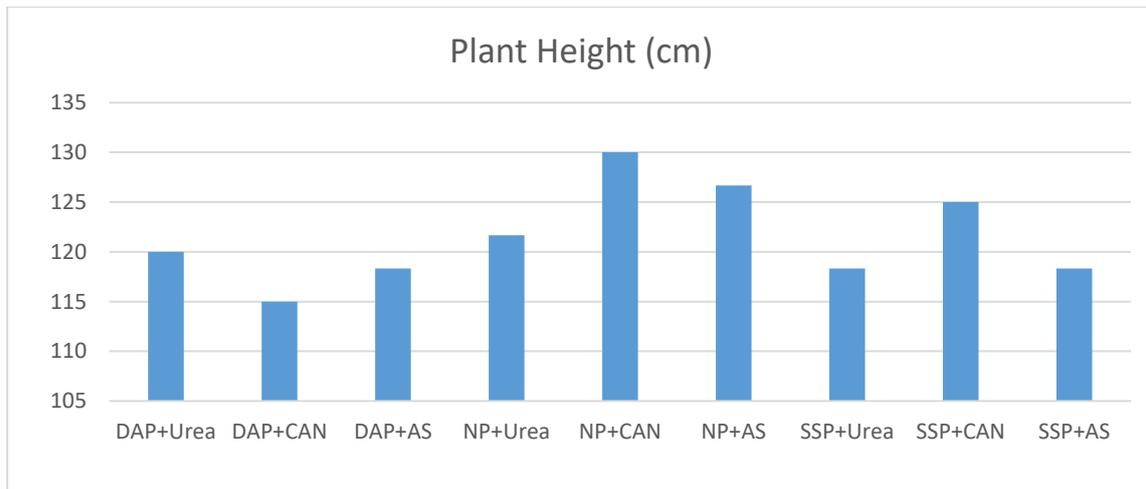


Figure 1 Plant height

Treatment 5 (Nitrophosphate + Calcium Ammonium Nitrate) performed best (Figure 1) as compared to the other treatments with 130 cm while pairwise comparison showed that all the treatments were expressing statistically non-significant difference with each other and all the treatments showed significant difference from the control.

Figure. 2

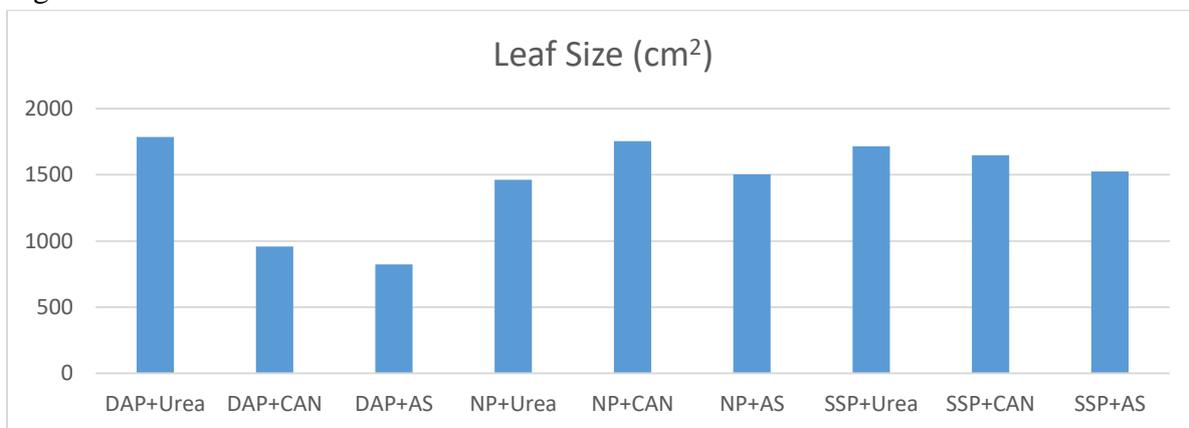


Figure 2 Leaf size cm²

Treatment 1 i.e. control (Di-Ammonium Phosphate + Urea) performed best (Figure 2) as compared to the other treatments with 1786.5 cm² while pairwise comparison showed that all the treatments were expressing statistically non-significant difference with each other and all the treatments showed significant difference from the control.

Figure. 3

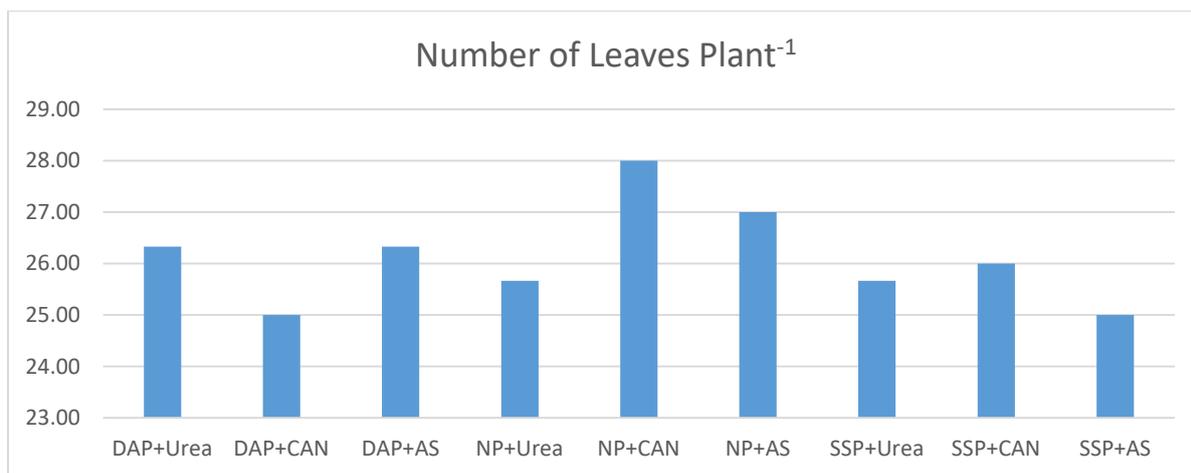


Figure 3. Number of leaves plant⁻¹

Treatment 5 (Nitrophosphate + Calcium Ammonium Nitrate) performed best (Figure 3) as compared to the other treatments with 28 number of leaves plant⁻¹ while pairwise comparison showed that all the treatments were expressing statistically non-significant difference with each other and all the treatments showed significant difference from the control.

Figure 4.

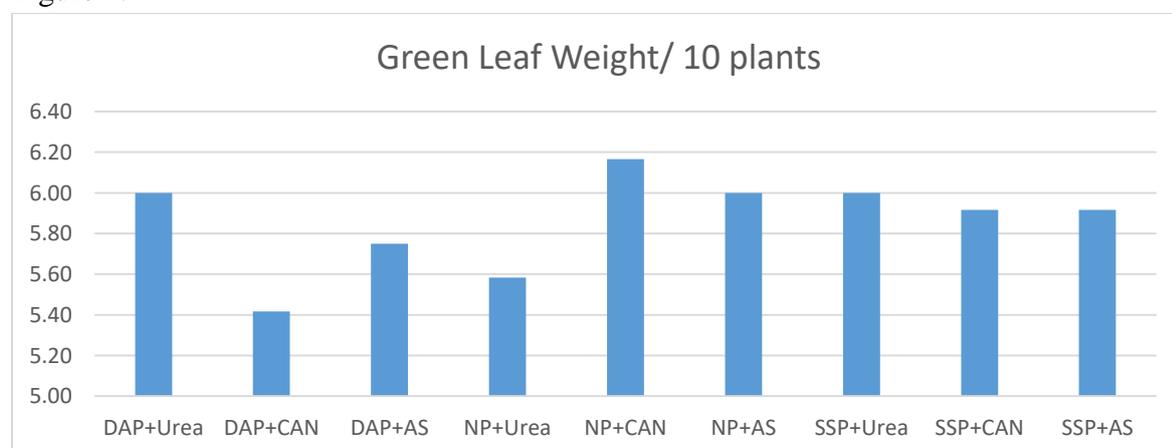


Figure 4 Green leaf weight (kg)

Treatment 5 (Nitrophosphate + Calcium Ammonium Nitrate) performed best (Figure 4) as compared to the other treatments with 6.17 kg while pairwise comparison showed that all the treatments were expressing statistically non-significant difference with each other and all the treatments showed significant difference from the control.

Figure 5.

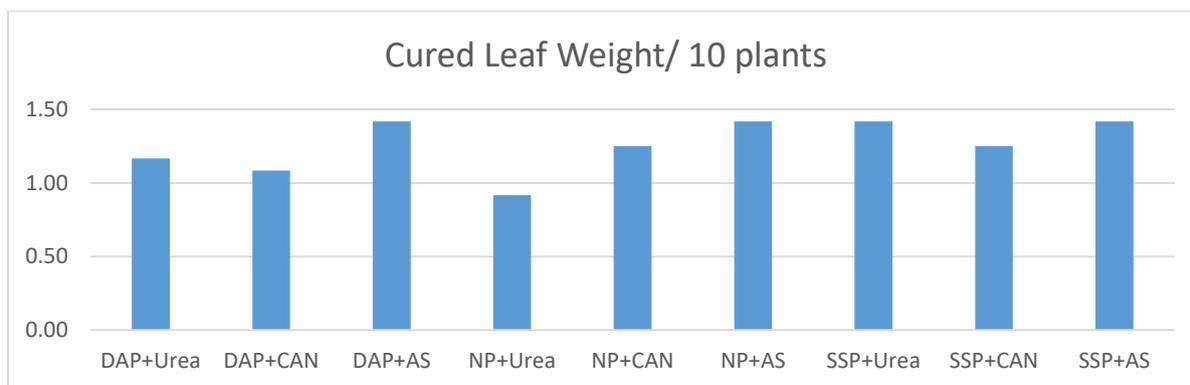


Figure 5 Cured leaf weight

Treatment 3, 6, 7 and 9 (Di-Ammonium Phosphate + Ammonium Sulphate, Nitro phosphate + Ammonium Sulphate, Single Super Phosphate + Urea and Single Super Phosphate + Ammonium Sulphate) performed best (Figure 5) as compared to the other treatments with 1.42, 1.42, 1.42 and 1.42 kg respectively while pairwise comparison showed that all the treatments were expressing statistically non-significant difference with each other and all the treatments showed significant difference from the control.

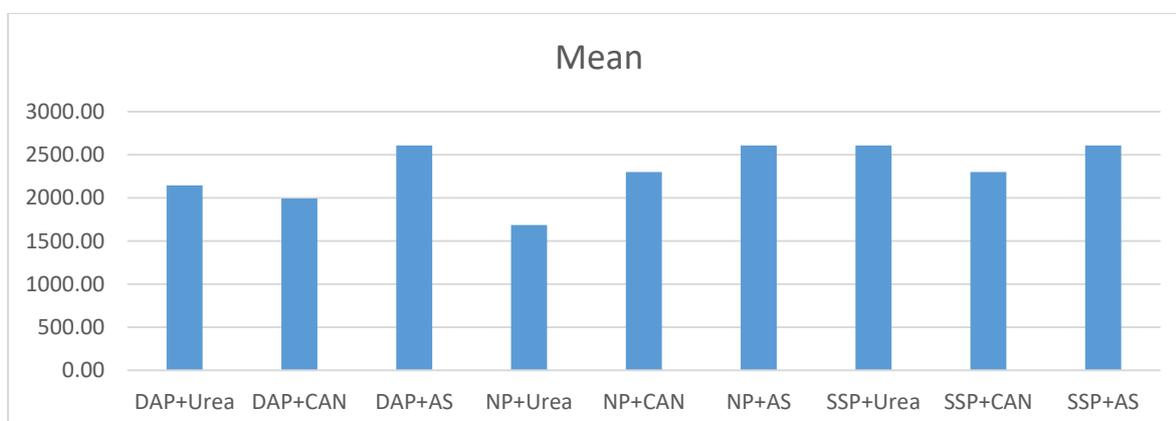


Figure 6. Cured Leaf Weight

Treatment 3, 6, 7 and 9 (Di-Ammonium Phosphate + Ammonium Sulphate, Nitro phosphate + Ammonium Sulphate, Single Super Phosphate + Urea and Single Super Phosphate + Ammonium Sulphate) performed best (Figure 5) as compared to the other treatments with 2606.67, 2606.67, 2606.67 and 2606.67 kg respectively while pairwise comparison showed that all the treatments were expressing statistically non-significant difference with each other and all the treatments showed significant difference from the control.

Recommendations:

In light of the above-mentioned data after statistical data it is recommended that Treatment 5 (Nitro phosphate + Calcium Ammonium Nitrate (CAN)) is best suited for parameters including plant height, number of leaves and green leaf weight in DAC Tobacco crop. This trial is being conducted from 2019-2022 and has to be completed. Upon conclusion analysis of 2 years data it is suggested

that application of a recommended dose of all fertilizer combinations should be continued till the completion of the project to know the nicotine and reducing sugar contents. This would be helpful to investigate the quality of tobacco leaf and thus overall recommendation of source based fertilizer (Nitrogen and Phosphorus) with best combination application in tobacco crop.

TITLE NO. 2: BUDWORM CONTROL TRIAL 2021

Research methodology

A research conducted to check the efficacy of different chemical pesticides to control the attack of Budworm on the DAC at Tobacco Research Sub-Station, Kunjah, Gujrat. Plants were planted while maintaining plant to plant and row to row distance of 60cm and 90cm respectively. Following six treatments were applied while using RCBD at the prescribed rate and 3 replications/blocks of each treatment were laid to cross check the effectiveness of the treatment.

S. No.	TREATMENTS
1	Karatay @ 200 ml/acre (Lambda Cyhalothrin)
2	Match @ 250 ml/acre (Lufeneron)
3	Talstar @ 250 ml/acre (Bifenthrin)
4	Volium flexi @ 80 ml/acre (Thiamethoxam and Chlorantraniliprole)
5	Belt @ 250 ml/acre (Flubendiamide)
6	Control (No Application)

Preventive dose of the pesticides was applied to the plants and after 5 days data was collected. Collected data was subjected to the statistical analysis which showed that the

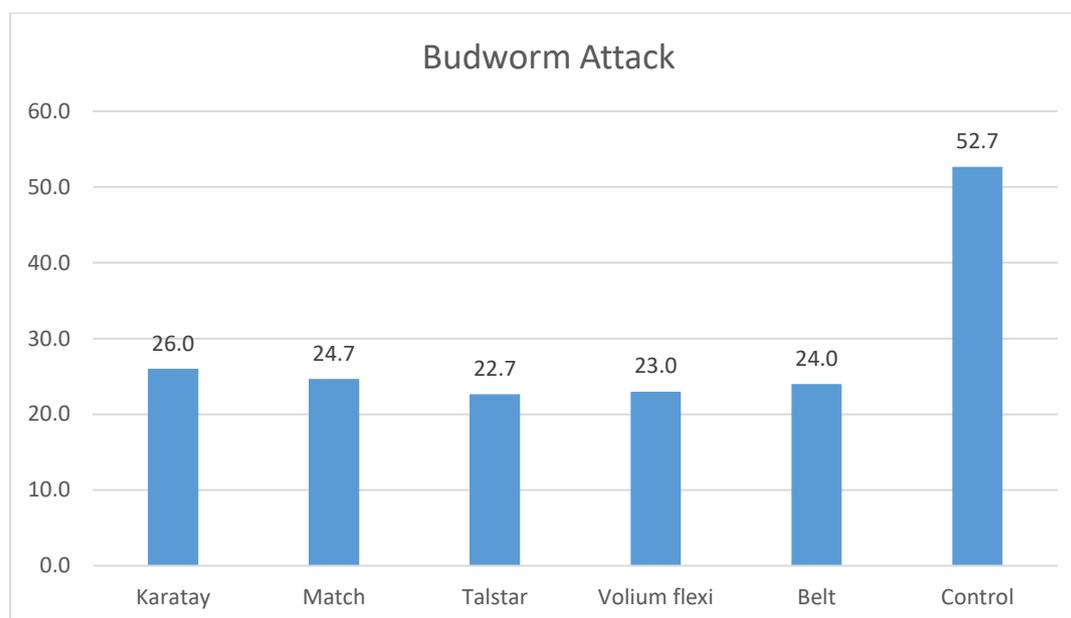


Figure 1. Budworm Attack

Treatment 4(Volium flexi) performed best (Figure 1) as compared to the other treatments while pairwise comparison showed that all the treatments were expressing statistically non-significant difference with each other and all the treatment (pesticides) showed significant difference from the control.

Recommendations:

In light of the above-mentioned data after statistical data it is recommended that Treatment 4 (volium flexi) is best suited for control of Budworm in Tobacco crop. This trial was conducted from 2019-2021 and has completed. Upon conclusion analysis of three years data suggest that budworm can be controlled by application of a recommended dose of any good quality pesticide available in market and severe economic loss to tobacco crop can be prevented.

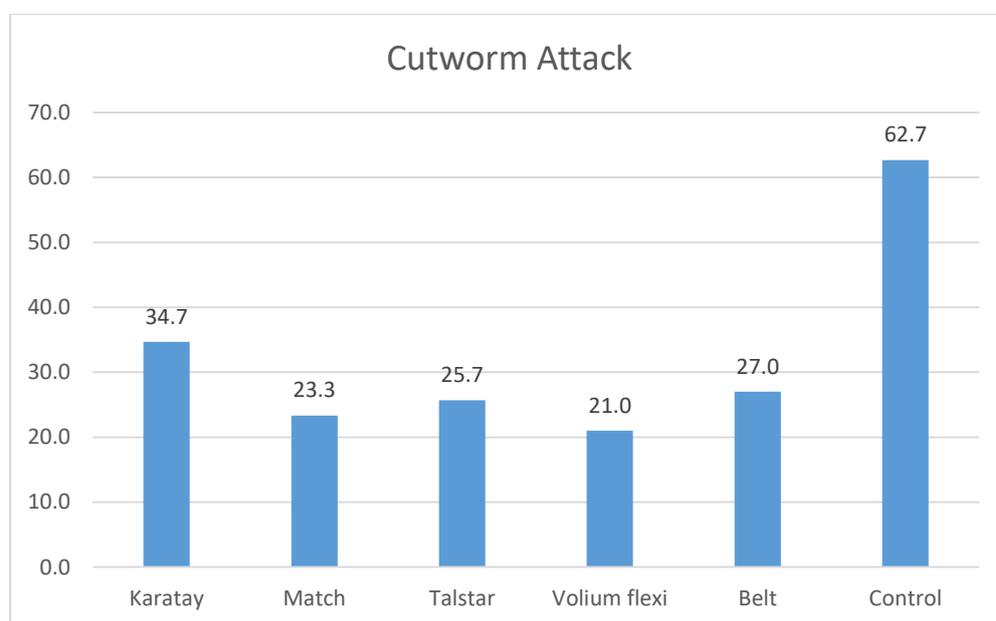
TITLE NO. 3: CUTWORM CONTROL TRIAL 2021

Material and methodology

A research trial conducted to check the efficiency of different chemical pesticides to control the attack of Cutworm on the DAC crop was conducted at Tobacco Research Sub-Station, Kunjah, Gujrat. Plants were planted while maintaining plant to plant and row to row distance of 60cm and 90cm respectively. Following six treatments were applied while using RCBD at the prescribed rate and 3 replications/blocks of each treatment were laid to cross check the effectiveness of the treatment.

S. No.	TREATMENTS
1	Karatay @ 200 ml/acre (Lambda Cyhalothrin)
2	Match @ 250 ml/acre (Lufenuron)
3	Talstar @ 250 ml/acre (Bifenthrin)
4	Volium flexi @ 80 ml/acre (Thiamethoxam and Chlorantraniliprole)
5	Belt @ 250 ml/acre (Flubendiamide)
6	Control (No Application)

Preventive dose of the pesticides was applied to the plants and after 5 days data was collected. Collected data was subjected to the statistical analysis which showed that the Treatment 4 (Volium flexi) performed best (Figure 2) closely followed by Treatment 2 (Match). Statistical analysis showed that treatment 4 was giving significant difference with respect to all the other varieties and there was less significant difference among treatment 2, 3 and 5 while all the pesticidal treatments showed significant difference with respect to the control.



Recommendations:

In light of the above-mentioned data after statistical analysis it is recommended that Treatment 4 (volium flexi) and Treatment 5 (Belt) are best suited for control of Cutworm in Tobacco crop. This trial was also conducted from 2019-2021 and has been completed. Statistical analysis of data upon completion of trial suggest that cutworm needs a combination of at least 2 pesticides (as in the case of Volium Flexi) to be effectively controlled and to contain its economic threshold under required level.

TITLE NO. 4: DAC VARIETAL TRIAL 2021

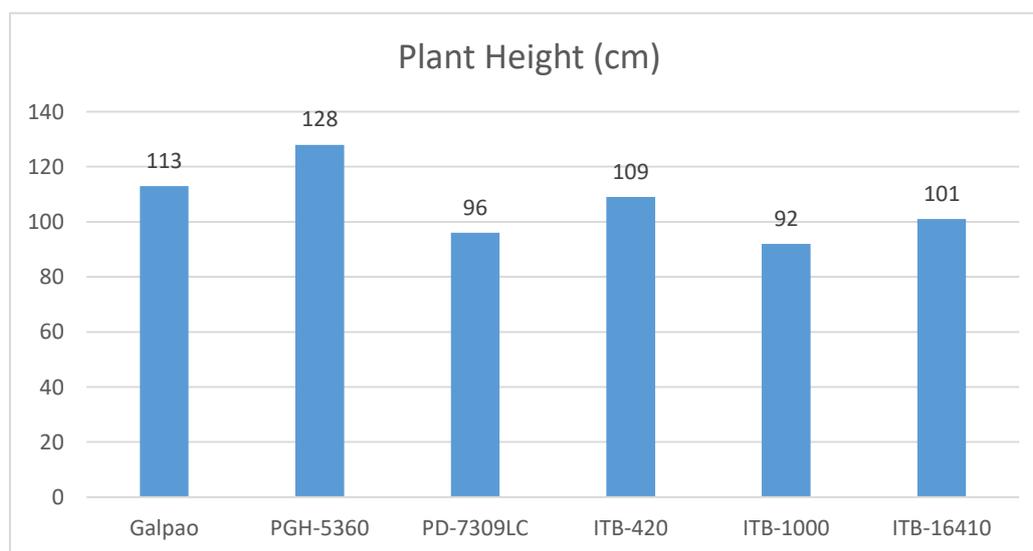
Material and Methodology

An experiment conducted to evaluate the response and efficacy of different varieties of DAC tobacco at Tobacco Research Sub-Station, Kunjah, Gujrat. Six following varieties were selected for the trial while maintaining plant to plant and row to row distance of 60cm and 90cm respectively using Randomized Complete Block Design to minimize the degree of error.

S. No.	VARIETIES
1	Galpao
2	PGH-5360
3	PD-7309LC
4	ITB-420
5	ITB-1000
6	ITB-16410

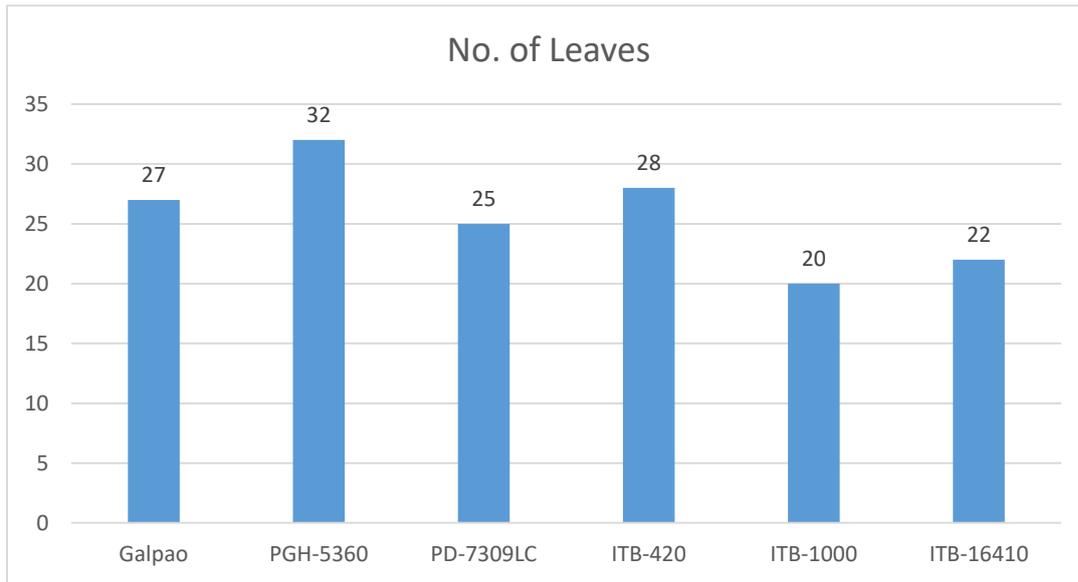
All the standard inputs and agronomic practices were carried out at homogenous level. Following parameters were studied and analyzed statistically after careful collection of data.

1. Plant height (cm)



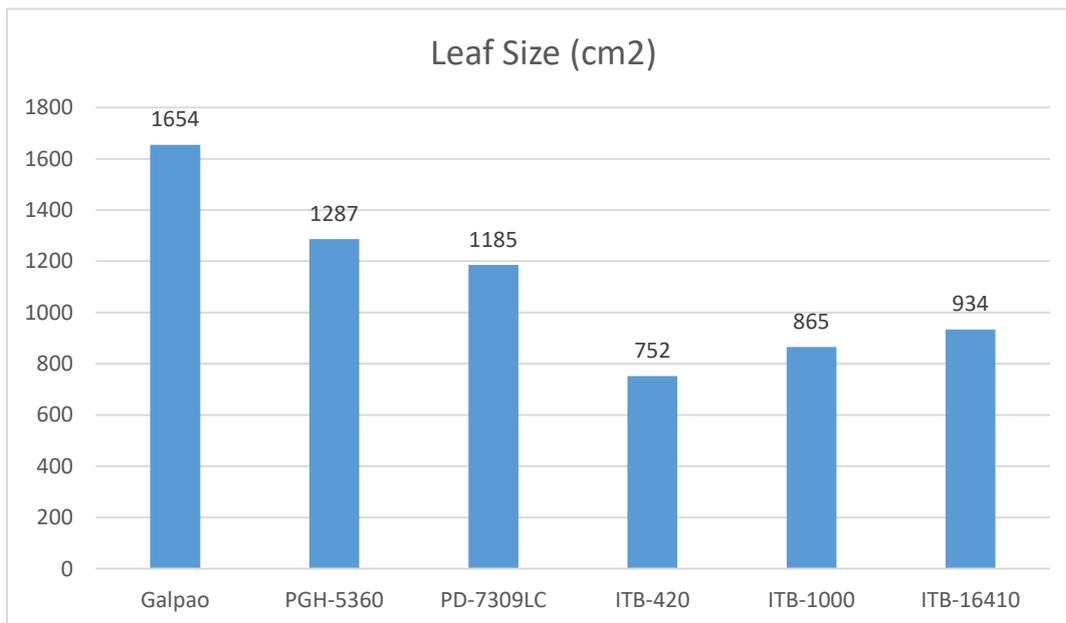
As above figure shows that all varieties were above 90 cm in plant height but PGH-5360 was best with 128 cm height and showed statistically significant difference followed by Galpao and other varieties while ITB-1000 was the least performing in this regard.

2. Number of Leaves Plant⁻¹



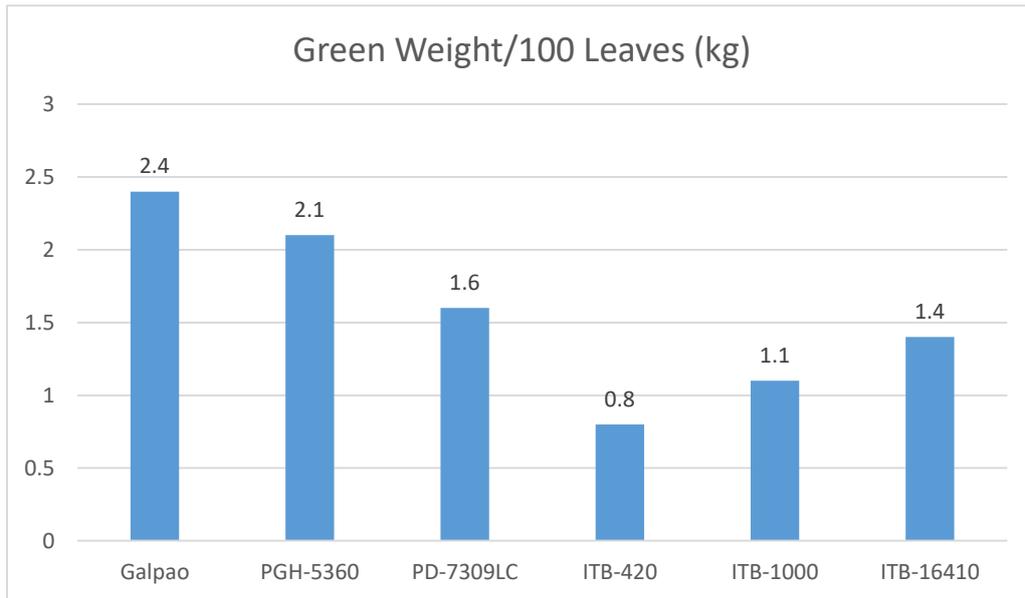
This chart clearly demonstrates that the variety PGH-5360 was well above all others and showed statistically significant difference with them too. As PGH-5360 were ahead with 32 number of leaves followed by ITB-420 and Galpao, which on average bore 28 & 27 leaves per plant, respectively and was significantly different from the 1st.

3. Leaf Area/Size (cm²)



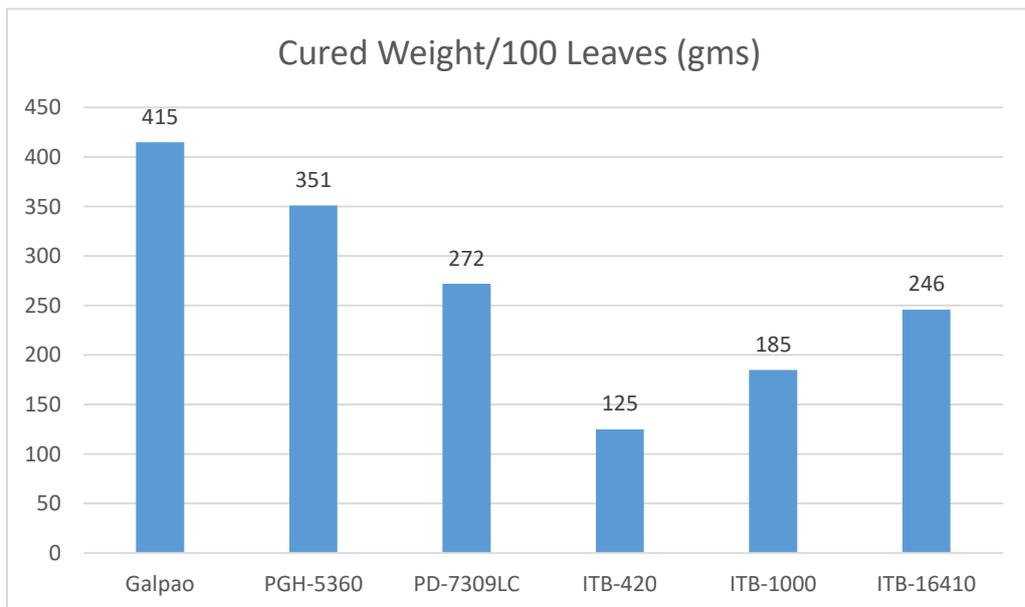
Performance of DAC varieties for Leaf Area/Size parameter was different from previous parameters as in this case Galpao was ahead by a large margin than other varieties and data analysis showed significantly different behavior with respect to other treatment followed only by PGH-5360 as expressed in above bar chart.

4. Green weight/100 leaves (kg)



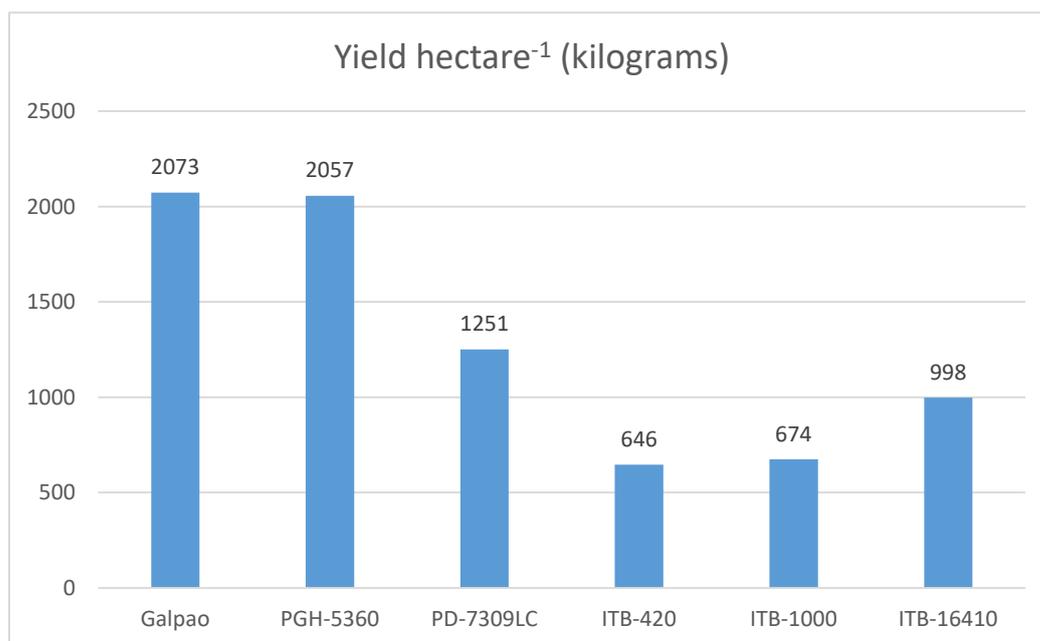
In respect of green weight, again Galpao was the best performing entity and five (5) groups of statistically different treatments were obtained after pair-wise comparisons leading with Galpao, followed by PGH-5360, then 3rd group (PD-7309 & ITB-16410) and at last 4th and 5th group of ITB-420 and ITB-1000 varieties respectively.

5. Cured weight/100 leaves (gms)



Statistical analysis of data for cured weight parameter exhibited that the treatments reciprocated their pattern of performance as noted for green weight parameter and is clearly comprehensible in the given figure too, Galpao performing top with PGH-5360 in second place and all others following.

6. Yield hectare⁻¹ (kg)



As above figure demonstrates that the Galpao bore maximum yield followed by PGH-5360 but there was not any statistically significant difference among these both, but these two do have significant difference with all the other varieties.

Recommendation

Obtained results support the recommendation of plantation of Galpao variety in Kunjah area so far, but for more rigorous testing it is recommended to continue the experiment at at-least three different locations for better results. It is also worth mentioning that this season there was a severe attack of TMV on tobacco crop but the two varieties (ITB-420 and ITB-1000) seemed adversely susceptible to the viral attack and lacked any vigor to cope with that.

VI. TOBACCO MODEL FARM (TMF), PISHIN

TITLE NO. 1: RUSTICA VARIETAL TRIAL PISHIN BALUCHISTAN

Research conducted to find out varietal performance of five rustica varieties namely Rustica 14, Rustica 15, Rustica 16, Rustica Hazro and Rustica L Pishin, were evaluated in a research with Randomized complete block design RCBD with three replications at grower field, the inter and intra line spacing in plants were kept a 75 cm and 22.5 cm respectively. All the recommended agronomical techniques were followed and fertilizer were applied at the time of ridge making.

The following agronomical parameters were recorded

Plant height (cm)

Leaves plant⁻¹

Cured weight plot⁻¹(Kg)

Cured yield ha⁻¹ (Kg).

Data Analyzing

The mean squares of genotypes and mean performance of parameters were calculated from collected data and data was subjected to analyzed in statistix 8.1 software,

Mean Squares

Mean squares of hybrid genotypes from ANOVA were carried out for 04 parameters recorded which affect the tobacco yield directly or indirectly. Mean Squares displayed that all the characters including: plant height (cm), leaves plant⁻¹, cured weight plot⁻¹(Kg), cured yield ha⁻¹ (Kg) exhibited highly significant differences at (P<0.01) for all examined genotypes showed in **Table1**.

Table 1 Mean squares of genotypes

Source of variation	Replications	Genotypes	Error
Degrees of freedom	2	4	8
Plant height	10.400	331.167***	10.567
Leaves per plant	8.2667	42.5000***	1.8500
Cured weight per plot kg	0.01363	0.72732*	0.12347
Yield per hectare	658	171651***	1811

*** highly significant , * significant at P> 0.05

Table 2 Mean performance

Genotype	Plant height (cm)	Leaves plant⁻¹	Cured weight plot⁻¹ (kg)	Cured yield hectare⁻¹ (Kg)
Rustica 14	57.00 b	9.33d	7.04c	2904 D
Rustica -15	53.33b	15.00b	7.29bc	3039c
Rustica 16	74.66a	19.00a	6.93c	2813e
Rustica –Hazro	47.00c	12.00c	7.73ab	3184b
Rustica-Local	53.00bc	11.33cd	8.11a	3419a

Mean performance

Plant height (cm)

The taller plants measured (**74.66 cm**) in genotypes **Rustica 6** and dwarf (**47.00 cm**) plants found in genotype **Rustica hazro** as described in shown in **Table 2**.

Number of leaves plant⁻¹

Higher number of leaves plant⁻¹ (**19.00**) were seen in line **Rustica 6** and lesser number (**9.33**) of leaves plant⁻¹ seen in **Rustica 14** shown in **Table 2**.

Cured weight plot⁻¹ (Kg)

According to the **Table 2** higher cured weight plot⁻¹ weighed (**8.11 kg**) in genotype **Rustica Local** and minimum cured weight plot⁻¹ weighed (**6.93 kg**) in genotype **Rustica 16**

Cured yield ha⁻¹ (Kg)

The optimum cured yield ha⁻¹ weighed (**3419 Kg**) in locally cultivated **Rustica Local** and minimum cured yield ha⁻¹ weighed (**2813 Kg**) in genotype **Rustica 16** shown in **Table 2**.

TITLE NO. 2: SPACING TRIAL RUSTICA 14

In order to identify an appropriate plant spacing for the production of quality rustica tobacco, the trial laid out in RCBD with three replications and conducted at farmers field variety rustica 14 was used and the following treatments of spacing were practiced.

S1 T1= 45 cm* 25 cm

S1T2= 45 cm * 30cm

S2 T1= 52.5 * 25.5cm

S2 T2 = 5. 5 cm * 30cm

S3 T1 = 60cm * 22.5cm

S3 T2= 60cm *30 cm

All recommended cultural practices were carried out through out tobacco growing season.

Statistical analyzing of the data

The data was statistically analyzed in statix 8.1 software.

Mean Squares

The traits, such as plant height (cm), number of leaves plant⁻¹, cured weight plot⁻¹ (kg), , cured yield ha⁻¹ (kg), differed significantly for all the characters among the tested genotypes. The genotype × transplanting interactions were also significantly different for majority of the studied traits shown in **Table 1**.

Table 1 Mean squares

Source of variances	Replicati ons (r-2)	Genotypes (G) (g-1)	spacing (T) (t-2)	G x S interaction (g-1)*(t-3)	Error (10)
Plant height (cm)	304.49	28.627**	39.944**	14.211**	39.407
Leaves plant ⁻¹	181.522	4.702**	40.622**	25.127**	13.314
Cured weight plot ⁻¹ (kg)	1.63535	0.03645ns	0.37552ns	1.48802ns	1.27120
Cured yield hectare ⁻¹ (kg)	1268614	12272***	6744***	1268614***	26291

*** highly significant, ** significant at P>0.01, ^{NS} non-significant

Mean performance

Table 2 Plant height (cm)

Spacing / Genotypes	Rustica 14
Spacing 1	54.05
Spacing 2	49.66
Spacing 3	49.50
Genotype average	
Source of Variation	LSD (P<0.05)
Genotype	6.59
Spacing	8.07
Genotype x spacing	11.420

From **Table 2** it is observed that, (~54.05 cm) plants observed in spacing 1 and lower plant height were measured in spacing 3.

Table 3 Leaves per plant

Spacing / Genotypes	Rustica 14
Spacing 1	22.383
Spacing 2	23.0
Spacing 3	18.217
Genotype average	
Source of Variation	LSD (P<0.05)
Genotype	3.832
Spacing	4.693
Genotype x spacing	6.638

The higher number of leaves per plant were counted in spacing 2 and minimum number of leaves counted in spacing 3. Illustrated in **Table 3**

Table 4 Cured weight per plot kilograms

Spacing / Genotypes	Rustica 14
Spacing 1	7.053
Spacing 2	6.66
Spacing 3	7.13
Genotype average	
Source of Variation	LSD (P<0.05)
Genotype	1.18
Spacing	1.45
Genotype x spacing	2.051

Maximum cured weight per plot weighed in spacing 3 and minimum cured weight per plot noted in spacing 1. Illustrated in **Table 4**

Table 5 Yield per hectare kilograms

Spacing / Genotypes	Rustica 14
Spacing 1	2595.3
Spacing 2	2550.2
Spacing 3	2529.8
Genotype average	
Source of Variation	LSD (P<0.05)
Genotype	170.31
Spacing	208.59
Genotype x spacing	294.99

The higher yield per hectare weighed in spacing 1 and minimum yield per hectare weighed in spacing 3.illustrated in **Table 5**

PART-B: EXTENSION SERVICE/DEVELOPMENT ACTIVITIES

There have been progressive increase in the yield and quality of various types of tobacco because of untiring efforts of Research and Development team of PTB, however, its scope is still wide. Tobacco quality yet needs further improvement for enhancing tobacco export and domestic consumption. The dissemination of technical know-how for better yield and quality is very important. The major developmental activities carried out were as under:

1. Laying out of Demonstration Plots

The field staff of Pakistan Tobacco Board laid out 5 demonstration plots in each tobacco growing areas for practical demonstration of latest technology to the tobacco growers. The inputs for these plots were provided by Pakistan Tobacco Board free of cost.

2. Crop monitoring reports

The extension officer of the Board furnished regularly crop monitoring reports to the Board's Head Office, Peshawar on weekly basis. After thoroughly examination of reports immediate instructions were issued regarding solution of the problems pointed out in the report.

3. **Topping/desuckering and use of suckericides**

The tobacco growers were guided and persuaded for effecting early stage topping and use of chemical suckericides to improve the yield and quality of tobacco crop and to get better grade index.

4. **Tobacco Workshops/Field Days**

Pakistan Tobacco Board arranged tobacco workshops in various tobacco growing areas of KP. The growers were informed about the targeted requirements of tobacco companies. The field officers of Pakistan Tobacco Board and Managers of tobacco companies also highlighted various aspects of tobacco crop production with special emphasis on picking of ripe/mature leaf to fetch better grade index for local industry and export purposes. The representatives of tobacco growers put forth their problems being faced by them for solution purpose.

Three day training workshop was also arranged at Tobacco Research Station Mardan from June 29 to July, 1, 2021 with the aim to better understand curing process, grading and marketing of tobacco.

Similarly with collaboration of tobacco companies, 08 field days/workshops were arranged at different stages of crop development. The growers were shown model/demonstration plots for adoption of best practices. The Tobacco companies also informed the growers about the latest technical knowledge for quality tobacco production.

5. **Growers' meetings Television Programme**

Training and visit programs (Growers' meetings) were organized in the tobacco growing areas of KP and various cultural operations regarding nursery raising were practically demonstrated to the growers.

6. **Streamlining of Fertilizer & Pesticides**

Regular meetings were arranged with the fertilizer and pesticide companies to ensure and streamline the availability of NPK fertilizer and pesticides in tobacco growing areas of KP.

7. **Modification in tobacco barns**

Campaign was launched both by the Board and tobacco companies for proper adjustment of flue-pipes, resetting of external chimneys and use of venture type of furnaces with the aim to conserve heat energy.

8. **Survey of tobacco barns**

To have a complete record of tobacco curing barns, the field staff of the Board and tobacco companies surveyed the tobacco growing areas.

9. **Dissemination of Technical know-how**

Technical know-how was disseminated through personal contacts, hand-outs, leaflets and radio talks for adoption by tobacco growers. For quality improvement and better grade index, the development staff of Pakistan Tobacco Board and tobacco companies continued motivation of tobacco growers regarding use of mechanization and proper suckericides application.

10. **Picking of ripe leaf and curing**

The tobacco growers were educated about proper curing and grading of tobacco. In this regard, the field staff of Pakistan Tobacco Board and tobacco companies carried out a campaign to highlight the significance of harvesting of ripe/mature leaf for curing to have better grade index for export purposes.

11. **Guide lines through Agricultural Slogans**

The Board's recommendations regarding raising ideal tobacco crop production were publicized through wall posters and erection of mud carrying Agricultural Slogans at appropriate places in the tobacco growing areas.

12. **Meeting of Assistant Development Officers**

Meetings of Assistant Development Officers and Research Officers of Pakistan Tobacco Board were carried out regularly during the season to discuss the crop situation, field activities and related matters at different stages of crop development.

13. **Soil and Tobacco leaf Analysis**

Soil and tobacco leaf samples pertaining to research projects collected from farmers' fields were forwarded to the Board's Chemistry laboratories for their chemical analysis. Approximately 399 samples were analyzed.

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APPENDIX OF ANOVA TABLES (TRSS, KUNJAH (GUJRAT))

Fertilizer Trial ANOVA 2021

Table 1. Randomized Complete Block AOV Table for Plant Height (cm)

Source	DF	SS	MS	F	P
Rep	2	229.63	114.815		
Treatment	8	557.41	69.676	0.48	0.8501
Error	16	2303.70	143.981		
Total	26	3090.74			

Grand Mean 121.48 CV 9.88

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	10.07	10.066	0.07	0.8010
Remainder	15	2293.64	152.909		

Relative Efficiency, RCB 0.97

Means of Plant Height for Treatment

Treatment	Mean
DAP+AS	118.33
DAP+CAN	115.00
DAP+Urea	120.00
NP+AS	126.67
NP+CAN	130.00
NP+Urea	121.67
SSP+AS	118.33
SSP+CAN	125.00
SSP+Urea	118.33
Observations per Mean	3
Standard Error of a Mean	6.9278
Std Error (Diff of 2 Means)	9.7973

Table 2. Randomized Complete Block AOV Table for No. of Leaves

Source	DF	SS	MS	F	P
Rep	2	29.556	14.7778		
Treatment	8	22.000	2.7500	0.34	0.9367
Error	16	129.111	8.0694		
Total	26	180.667			

Grand Mean 26.111 CV 10.88

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	22.061	22.0608	3.09	0.0991
Remainder	15	107.050	7.1367		

Relative Efficiency, RCB 1.05

Means of No. of Leaves for Treatment

Treatment	Mean
DAP+AS	26.333
DAP+CAN	25.000
DAP+Urea	26.333
NP+AS	27.000

NP+CAN 28.000
 NP+Urea 25.667
 SSP+AS 25.000
 SSP+CAN 26.000
 SSP+Urea 25.667
 Observations per Mean 3
 Standard Error of a Mean 1.6401
 Std Error (Diff of 2 Means) 2.3194

Table 3. Randomized Complete Block AOV Table for Leaf Size (cm²)

Source	DF	SS	MS	F	P
Rep	2	116781	58391		
Treatment	8	2876459	359557	3.46	0.0165
Error	16	1661624	103851		
Total	26	4654865			

Grand Mean 1464.1 CV 22.01

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	1232499	1232499	43.08	0.0000
Remainder	15	429125	28608		

Relative Efficiency, RCB 0.96

Means of Leaf Area for Treatment

Treatment	Mean
DAP+AS	823.0
DAP+CAN	957.9
DAP+Urea	1786.6
NP+AS	1502.8
NP+CAN	1754.6
NP+Urea	1461.4
SSP+AS	1525.2
SSP+CAN	1648.9
SSP+Urea	1716.6
Observations per Mean	3
Standard Error of a Mean	186.06
Std Error (Diff of 2 Means)	263.12

Table 4. Randomized Complete Block AOV Table for Green Leaf Weight/10 Plant (kg)

Source	DF	SS	MS	F	P
Rep	2	0.26389	0.13194		
Treatment	8	1.33333	0.16667	0.87	0.5612
Error	16	3.06944	0.19184		
Total	26	4.66667			

Grand Mean 5.8611 CV 7.47

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	0.01282	0.01282	0.06	0.8054
Remainder	15	3.05663	0.20378		

Relative Efficiency, RCB 0.97

Means of Green Leaf Weight for Treatment

Treatment	Mean
DAP+AS	5.7500
DAP+CAN	5.4167
DAP+Urea	6.0000
NP+AS	6.0000
NP+CAN	6.1667
NP+Urea	5.5833
SSP+AS	5.9167
SSP+CAN	5.9167
SSP+Urea	6.0000
Observations per Mean	3
Standard Error of a Mean	0.2529
Std Error (Diff of 2 Means)	0.3576

Table 5. Randomized Complete Block AOV Table for Cured Leaf Weight/10 Plants (kg)

Source	DF	SS	MS	F	P
Rep	2	0.12963	0.06481		
Treatment	8	0.76852	0.09606	1.48	0.2390
Error	16	1.03704	0.06481		
Total	26	1.93519			

Grand Mean 1.2593 CV 20.22

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	0.01018	0.01018	0.15	0.7051
Remainder	15	1.02685	0.06846		

Relative Efficiency, RCB 0.99

Means of Cured Leaf Weight for Treatment

Treatment	Mean
DAP+AS	1.4167
DAP+CAN	1.0833
DAP+Urea	1.1667
NP+AS	1.4167
NP+CAN	1.2500
NP+Urea	0.9167
SSP+AS	1.4167
SSP+CAN	1.2500
SSP+Urea	1.4167
Observations per Mean	3
Standard Error of a Mean	0.1470
Std Error (Diff of 2 Means)	0.2079

Table 1. Randomized Complete Block AOV Table for Budworm Attack

Source	DF	SS	MS	F	P
Reps	2	163.00	81.500		
Treats	5	2066.50	413.300	11.20	0.0008
Error	10	369.00	36.900		
Total	17	2598.50			

Grand Mean 28.833 CV 21.07

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	298.680	298.680	38.23	0.0002
Remainder	9	70.320	7.813		

Relative Efficiency, RCB 1.12

Means of Budworm Attack for Treats

Treats Mean

1	26.000
2	24.667
3	22.667
4	23.000
5	24.000
6	52.667

Observations per Mean 3
 Standard Error of a Mean 3.5071
 Std Error (Diff of 2 Means) 4.9598

Table 2. LSD All-Pairwise Comparisons Test of Budworm Attack for Treats

Treats Mean Homogeneous Groups

6	52.667	A
1	26.000	B
2	24.667	B
5	24.000	B
4	23.000	B
3	22.667	B

Alpha 0.05 Standard Error for Comparison 4.9598
 Critical T Value 2.228 Critical Value for Comparison 11.051
 Error term used: Reps*Treats, 10 DF
 There are 2 groups (A and B) in which the means are not significantly different from one another.

Table 3. Randomized Complete Block AOV Table for Cutworm Attack

Source	DF	SS	MS	F	P
Reps	2	6.78	3.389		
Treats	5	3623.61	724.722	78.87	0.0000
Error	10	91.89	9.189		
Total	17	3722.28			

Grand Mean 32.389 CV 9.36

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	19.2239	19.2239	2.38	0.1572
Remainder	9	72.6650	8.0739		

Relative Efficiency, RCB 0.90

Means of Cutworm Attack for Treats

Treats Mean

1	34.667
2	23.333
3	25.667
4	21.000
5	27.000
6	62.667

Observations per Mean 3
 Standard Error of a Mean 1.7501
 Std Error (Diff of 2 Means) 2.4751

Table 4. LSD All-Pairwise Comparisons Test of Cutworm Attack for Treats

Treats	Mean	Homogeneous Groups
6	62.667	A
1	34.667	B
5	27.000	C
3	25.667	CD
2	23.333	CD
4	21.000	D

Alpha 0.05 Standard Error for Comparison 2.4751
 Critical T Value 2.228 Critical Value for Comparison 5.5148
 Error term used: Reps*Treats, 10 DF
 There are 4 groups (A, B, etc.) in which the means are not significantly different from one another.

Table 1. Randomized Complete Block AOV Table for Plant Height (cm)

Source	DF	SS	MS	F	P
Reps	3	107.67	35.889		
Varieties	5	3446.00	689.200	8.51	0.0005
Error	15	1214.33	80.956		
Total	23	4768.00			

Grand Mean 106.50 CV 8.45

Tukey's 1 Degree of Freedom Test for Non-additivity

Source	DF	SS	MS	F	P
Non-additivity	1	0.39	0.3936	0.00	0.9472
Remainder	14	1213.94	86.7100		

Relative Efficiency, RCB 0.91

Means of Plant Height (cm) for Varieties

Varieties	Mean
Galpao	113.00
ITB-1000	92.00
ITB-16410	101.00
ITB-420	109.00
PD-7309LC	96.00
PGH-5360	128.00
Observations per Mean	4
Standard Error of a Mean	4.4988
Std Error (Diff of 2 Means)	6.3622

Table 2. LSD All-Pairwise Comparisons Test of Plant Height (cm) for Varieties

Varieties	Mean	Homogeneous Groups
PGH-5360	128.00	A
Galpao	113.00	B
ITB-420	109.00	BC
ITB-16410	101.00	BCD
PD-7309LC	96.00	CD
ITB-1000	92.00	D

Alpha 0.05 Standard Error for Comparison 6.3622
 Critical T Value 2.131 Critical Value for Comparison 13.561
 Error term used: Reps*Varieties, 15 DF
 There are 4 groups (A, B, etc.) in which the means are not significantly different from one another.

Table 3. Randomized Complete Block AOV Table for No of Leaves

Source	DF	SS	MS	F	P
Reps	3	8.667	2.8889		
Varieties	5	373.333	74.6667	12.26	0.0001
Error	15	91.333	6.0889		
Total	23	473.333			

Grand Mean 25.667 CV 9.61

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	5.7234	5.72344	0.94	0.3497
Remainder	14	85.6099	6.11499		

Relative Efficiency, RCB 0.92

Means of No of Leaves for Varieties

Varieties	Mean
Galpao	27.000
ITB-1000	20.000
ITB-16410	22.000
ITB-420	28.000
PD-7309LC	25.000
PGH-5360	32.000
Observations per Mean	4
Standard Error of a Mean	1.2338
Std Error (Diff of 2 Means)	1.7448

Table 4. LSD All-Pairwise Comparisons Test of No of Leaves for Varieties

Varieties	Mean	Homogeneous Groups
PGH-5360	32.000	A
ITB-420	28.000	B
Galpao	27.000	B
PD-7309LC	25.000	BC
ITB-16410	22.000	CD
ITB-1000	20.000	D

Alpha 0.05 Standard Error for Comparison 1.7448
 Critical T Value 2.131 Critical Value for Comparison 3.7190
 Error term used: Reps*Varieties, 15 DF
 There are 4 groups (A, B, etc.) in which the means are not significantly different from one another.

Table 5. Randomized Complete Block AOV Table for Leaf Size (cm²)

Source	DF	SS	MS	F	P
Reps	3	414374	138125		
Varieties	5	2208027	441605	11.29	0.0001
Error	15	586554	39104		
Total	23	3208955			

Grand Mean 1112.8 CV 17.77

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	150910	150910	4.85	0.0449
Remainder	14	435644	31117		

Relative Efficiency, RCB 1.31

Means of Leaf Size (cm²) for Varieties

Varieties	Mean
Galpao	1654.0
ITB-1000	865.0
ITB-16410	934.0
ITB-420	752.0
PD-7309LC	1185.0
PGH-5360	1287.0
Observations per Mean	4
Standard Error of a Mean	98.873
Std Error (Diff of 2 Means)	139.83

Table 6. LSD All-Pairwise Comparisons Test of Leaf Size (cm²) for Varieties

Varieties	Mean	Homogeneous Groups
Galpao	1654.0	A
PGH-5360	1287.0	B
PD-7309LC	1185.0	BC
ITB-16410	934.0	CD
ITB-1000	865.0	D
ITB-420	752.0	D

Alpha 0.05 Standard Error for Comparison 139.83
 Critical T Value 2.131 Critical Value for Comparison 298.04
 Error term used: Reps*Varieties, 15 DF
 There are 4 groups (A, B, etc.) in which the means are not significantly different from one another.

Table 7. Randomized Complete Block AOV Table for Green weight/100 leaves (kg)

Source	DF	SS	MS	F	P
Reps	3	0.20333	0.06778		
Varieties	5	7.25333	1.45067	54.86	0.0000
Error	15	0.39667	0.02644		
Total	23	7.85333			

Grand Mean 1.5667 CV 10.38

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	0.07329	0.07329	3.17	0.0966
Remainder	14	0.32338	0.02310		

Relative Efficiency, RCB 1.18

Means of Green weight/100 leaves (kg) for Varieties

Varieties	Mean
Galpao	2.4000
ITB-1000	1.1000
ITB-16410	1.4000
ITB-420	0.8000

PD-7309LC 1.6000
 PGH-5360 2.1000
 Observations per Mean 4
 Standard Error of a Mean 0.0813
 Std Error (Diff of 2 Means) 0.1150

Table 8. LSD All-Pairwise Comparisons Test of Green weight/100 leaves (kg) for Varieties

Varieties	Mean	Homogeneous Groups
Galpao	2.4000	A
PGH-5360	2.1000	B
PD-7309LC	1.6000	C
ITB-16410	1.4000	C
ITB-1000	1.1000	D
ITB-420	0.8000	E

Alpha 0.05 Standard Error for Comparison 0.1150
 Critical T Value 2.131 Critical Value for Comparison 0.2451
 Error term used: Reps*Varieties, 15 DF
 There are 5 groups (A, B, etc.) in which the means are not significantly different from one another.

Table 9. Randomized Complete Block AOV Table for Cured weight/100 leaves (gms)

Source	DF	SS	MS	F	P
Reps	3	7639	2546.3		
Varieties	5	225213	45042.7	50.74	0.0000
Error	15	13317	887.8		
Total	23	246169			

Grand Mean 265.67 CV 11.22

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	3865.37	3865.37	5.73	0.0313
Remainder	14	9451.63	675.12		

Relative Efficiency, RCB 1.22

Means of Cured weight/100 leaves (gms) for Varieties

Varieties	Mean
Galpao	415.00
ITB-1000	185.00
ITB-16410	246.00
ITB-420	125.00
PD-7309LC	272.00
PGH-5360	351.00
Observations per Mean	4
Standard Error of a Mean	14.898
Std Error (Diff of 2 Means)	21.069

Table 10. LSD All-Pairwise Comparisons Test of Cured weight/100 leaves (gms) for Varieties

Varieties	Mean	Homogeneous Groups
Galpao	415.00	A
PGH-5360	351.00	B
PD-7309LC	272.00	C
ITB-16410	246.00	C

ITB-1000 185.00 D
 ITB-420 125.00 E

Alpha 0.05 Standard Error for Comparison 21.069
 Critical T Value 2.131 Critical Value for Comparison 44.907
 Error term used: Reps*Varieties, 15 DF
 There are 5 groups (A, B, etc.) in which the means are not significantly different from one another.

Table 11. Randomized Complete Block AOV Table for Yield kg/hectare

Source	DF	SS	MS	F	P
Reps	3	298530	99510		
Varieties	5	8328299	1665660	38.76	0.0000
Error	15	644688	42979		
Total	23	9271517			

Grand Mean 1283.2 CV 16.16

Tukey's 1 Degree of Freedom Test for Nonadditivity

Source	DF	SS	MS	F	P
Nonadditivity	1	251751	251751	8.97	0.0096
Remainder	14	392937	28067		

Relative Efficiency, RCB 1.15

Means of Yield kg/hectare for Varieties

Varieties	Mean
Galpao	2073.0
ITB-1000	674.0
ITB-16410	998.0
ITB-420	646.0
PD-7309LC	1251.0
PGH-5360	2057.0
Observations per Mean	4
Standard Error of a Mean	103.66
Std Error (Diff of 2 Means)	146.59

Table 12. LSD All-Pairwise Comparisons Test of Yield kg/hectare for Varieties

Varieties	Mean	Homogeneous Groups
Galpao	2073.0	A
PGH-5360	2057.0	A
PD-7309LC	1251.0	B
ITB-16410	998.0	B
ITB-1000	674.0	C
ITB-420	646.0	C

Alpha 0.05 Standard Error for Comparison 146.59
 Critical T Value 2.131 Critical Value for Comparison 312.46
 Error term used: Reps*Varieties, 15 DF
 There are 3 groups (A, B, etc.) in which the means are not significantly different from one another.

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