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THE EFFECT OF POPULATION DYNAMICS OF INSECT PESTS ON DIFFERENT VARIETIES OF SUGAR BEET

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ABSTRACT

An experiment was conducted at Sugar Crop Research Institute (SCRI), Mardan to investigate the population dynamics of insect pests on different varieties of sugar beet. The results revealed that Kawa Terma was the most resistant variety to aphids (*Aphis fabae* (Scop)) (3.96), KWS. 9212 to armyworm (*Spodoptera* spp.) (3.17), budworms (*Helicoverpa armigera* (Hubner)) (1.43), cutworm (*Agrotis ipsilon* (Hfn)) (2.13), grasshopper (*Chrotogonus trachyptrus* (Blanch)) (4.84) and semilooper (*Anomis sabulifera* (Guenee)) (3.71). While the most susceptible variety was Tenor to aphids (*Aphis fabae* (Scop)) (19.72), armyworm (*Spodoptera* spp.) (21.36), budworm (*Helicoverpa armigera* (Hubner)) (11.31), cutworm (*Agrotis ipsilon* (Hfn)) (15.87), grasshopper (*Chrotogonus trachyptrus* (Blanch)) (21.06) and semilooper (*Anomis sabulifera* (Guenee)) (21.64). SM. 1395/Atlanta was the highest yielding variety while KWS. 9212 were reported to be the best quality treatment.

Keywords: *Rice, Rural Women, Iran.*

INTRODUCTION

Sugar beet (*Beta vulgaris* L.), locally known as `cheqandar', belongs to family Chenopodiaceae. It is a biennial crop and completes its vegetative growth in two seasons. In first season it develops a large fleshy root, which stores the reserved food, while in second season it produces flowers and seeds. Sugar beet has a large tape root, which gradually tapers into a relatively long root. The cone shaped root ranges from 0.9 to 3 kg or more in weight. The root size is dependent on stand, soil fertility, soil moisture, and length of season, freedom from diseases, insect pests and other factors. It is a unique crop because it stores a very high amount of pure sucrose in its root.

Sugar beet is more economical crop than sugarcane. It contains 30% more sugar than that of sugarcane and requires less fertilizer as compared to sugarcane. Sugar beet being a short season crop offers an excellent opportunity for better crop rotation in NWFP. It provides not only sugar but also green fodder and molaces for cattle and poultry feed (Khan, 1985).

Sugar beet is cultivated in about 40 countries of the world and accounts for 40-45% of the world total sugar production. It is successfully grown as a summer crop in areas lying above 30^0N whereas sugarcane, predominantly a tropical crop, is grown

between 30^0 latitude North-South. But there is an intermediate zone, i.e. $30\text{-}35^0$ where both the crops are cultivated and NWFP falls in this range. On the world basis, beet crop occupies second position in cropping pattern of sugar production.

Beet has been a domesticated companion of man for many centuries. Mediterranean cultures as long ago as 3000 B.C. used descendants of the wild *Beta maritima* for food and medicinal purposes. The present type of beet grew in wild parts of Asia and at an early time it was cultivated in Southern Europe and Egypt. Despite its long lineage, sweet types were not reported until the 1500's. Early in the 1600's it was demonstrated in France that the beetroot contains juice similar to cane sugar. However, it was not until 1747 that commercial sugar was produced from beets in Europe in the laboratory by a German Chemist, Andreas Marcygraf, which enabled him to install a factory at the end of 18th century at Cunern in Silesia, Germany.

NWFP is unique throughout Pakistan where both the sugar crops are grown simultaneously in the same field. Beet is sown in September - October and harvested in May - June. Sugar beet has been in commercial cultivation in NWFP particularly in the Peshawar Valley since 1958. It has become a successful industrial crop of the Valley because of the development of satisfactory process for recovering sugar from beet roots, satisfactory control over insect pests and the use of high yielding varieties. Following research achievements and better results of root and sugar yields, slicing of beet crop in the region was first initiated by Charasadda Sugar Mills in 1959. Premier Sugar Mills, Mardan and Frontier Sugar Mills followed it; Takht-e-Bhai in 1966, while Khazana Sugar Mills, Peshawar was equipped with a beet slicing plant since 1977.

Like other crops, beet varieties run-out after certain period of commercial cultivation. The continuous cultivation of the same variety in particular area creates the problem of insect pests and diseases. In Pakistan the insect pests take a heavy toll from sugar beet crop. In U.S.A it has been reported that 12 insects and 4 nematodes take heavy toll from sugar beet production. Scientist in U.S.S.R. Observed that about 63 species of insects and 2 mollus3cs attack the sugar beet crop. The most serious pests are *Aphis fabae* Scop. (Fam. Aphididae); *Chaetocnema concinna (*Marsham.) (Fam. Elateridae); *Peqomya hyoseyami* (Panz.) (Fam. Anthomyiidae); *Aclypae opaca* (L.) (Fam Silphidae); *Silpha exlamationis* (L.) (Fam. Silphidae); and other species of Lepioptera (Mian, 1979).

The insect pests found in our province were listed by Shahid (1987) as cutworm (*Agrotis ipsilon* Hfn.)), *A. seqetum* (Schiff.) (Fam. Noctuidae); grass hopper (*Chrotogronus trachypterus* (Blanch) (Fam. Acrididae); field cricket (*Gryllus bimacutalus* (DeGeer) (Fam. Gyllidae); mole cricket (*Gryllotalpa africana* (Beauvois.) (Fam. Gryllotalphidae); aphids (*Myzus persicae* (Sulz.) *Acryrthosiphon pisum* (Harris), *Aphis fabae* Scop. (Walk.), *Diachrysia orichalcea* (F.), *Mythimna separata* (Wlk.) *Mythimna loreyi (*Dup.) (Fam. Noctuidae).

Keeping in view the importance of sugar beet crop in the economy of local agriculture and in the interest of the nation, it is therefore, felt necessary to design an experiment to achieve the following objectives.

OBJECTIVES:

1. To screen out the relative resistance of different sugar beet varieties against insect/pests.
2. To see the effect of insect/pests on yield and quality of sugar beet.

MATERIALS AND METHODS

The experiment "Population dynamic density of insect pests in different varieties of sugar beet" was conducted at the Department of Entomology NWFP Agricultural University, Peshawar, during 2009-2010 crop season. The research was conducted at Sugar Crop Research Institute (SCRI) Mardan. The experiment was done on ten sugar beet varieties of different origin and genetic background.

10 varieties namely were selected at the crop sowing season on the basis of their characteristics. The experiment was conducted on a Randomized Complete Block Design (RCBD) having 10 treatments replicated 4 times. In all there were forty plots, normal agronomic cultural practices were followed in all the plots i.e. fertilizer application (P_2O_5) 120 kg/ha + N 90 kg/ha at sowing, N 50 kg/ha in early spring, irrigation, hoeing and weeding etc. row to row and plant to plant distance were kept 60 cm and 20 cm, respectively and counted 2 seeds were sown.

3.1 Population dynamics

To investigate the population dynamics of aphids, army warm, budworm, cutworm, grasshopper and semi looper, the insect pests infestation data were recorded at fortnight internal w.e.f. October 2009 to May/June 2010. There were six rows in each plot, out of which three rows were randomly selected. Then in each row, five plants were selected randomly for pest incidence. The data of insect pests population was recorded by counting their actual number on sugar beet plants.

3.2 Yield

The sugar beet root yield data was collected at the time of harvesting by weighting the sugar beet root with the help of a balance.

3.3 Quality

Sample of two beets from each plot were sent to P.B.G. Lab. at (SCRI) Mardan for quality analysis i.e. Brix %, Pol % and Purity %.

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RESULTS AND DISCUSSION

RESULTS

4.1 Population dynamics

4.1.1.Aphid (Aphis fabae (Scop))

Table 1 in summarized form shows the population dynamics of aphids (Aphis fabae (Scop) in different varieties of sugar beet. The highest population dynamics was recorded in M.9256 which was 20.96. It was followed by Tener (19.72), Mezzano AU Poly (15.58), KWS. 9271 (13.13), SM. 1395/Atlanta (11.67) and M. 9255 (8.04).

The population dynamics was 7.33 on SM. 1890, 6.88 (Trebyx), 6.04 (KWS. 9212) and 3.96 (Kawa Terma). These results show that the highest population dynamics was recorded in M. 9256, (20.96), while the lowest population dynamics of Aphid was recorded in Kawa Terma (3.96) which was non-significant compared with KWS. 9212 (6.04), while M. 9256 (20.96) and Tenor (19.72) were the most susceptible varieties against aphids (Aphis fabae (Scop). The ANOVA (Appendix) for population dynamics of aphids (Aphis fabae (Scop) on ten sugar beet varieties showed significant F-value for both the time internal and the varieties (P>0.05).

4.1.2Armyworm (Spodoptera spp.)

Data about the population dynamics of armyworm (Spodoptera spp.) in different vartieties of sugar beet are given in Table 2 and complete data in appendix 11.

The data shows that the highest population dynamics of armyworm (Spodoptera spp.) was recorded on genotype Tenor which was 21.36, followed by
SM. 1890 (8.29), M. 9256 (7.47), M. 9255 (7.19), Mezzano AU Poly (7.04) and Kawa Terma (6.49).

The armyworm (Spodoptera spp.) population was 6.08 (Trebyx), 5.79 (KWS. 9212) (3.17). The lowest armyworm (Spodoptera spp.) population was recorded in KWS. 9212 (3.17) which was non-significant with SM. 1395/Atlanta (4.96). The most susceptible varieties were Tenor and SM. 1890, while KWS. 9212 is the more resistant one. Almost in all cases the interaction of time interval with various varieties was found to be non-significant.

The ANOVA (Appendix) for population dynamics of armyworm (Spodoptera spp.) on ten sugar beet varieties showed significant. F-value for both the time internal and the varieties (P>0.05).

4.1.3.Budworm (Helicoverpa armigera (Hubner))

Table 3 in summarized form shows the population dynamics of budworm (Helicoverpa armigera) in ten sugar beet varieties.

The highest population dynamics of budworm (Helicoverpa armigera) was recorded in Tenor which was 11.31, followed by M.9256 (5.05) KWS. 9271 (94.49), SM. 1395/Atlanta (4.36), Mezzano AU Poly (4.04) and Trebyx (3.71), respectively.

The lowest population dynamics was recorded in KWS. 9212 i.e. (1.43) which was non-significant with M. 9255 (2.70), followed by Kawa Terma (2.88) and SM. 1890 (3.31). These results show that the most resistant variety against budworm (Helicoverpa armigera) is KWS. 9212, followed by Kawa Terma while the most susceptible varieties were Tenor and M. 9256. Statistical analysis showed highly
significant. F-value for both the time interval and the varieties (P>0.05). ANOVA has been presented in the Appendix.

4.1.4Cutworm (Agrotis ipsilon (Hfn))

Data about the population dynamics of cutworm (Agrotis ipsilon) in summarized form are given in Table 4 and detail data in Appendix 27. The table shows that the lowest population dynamics was recorded in KWS. 9212 (2.31) which was non-significant with Trebyx (3.78), followed by SM. 1395/Atlanta (3.96), M. 9255 (4.12), KWS. 9271 (4.13) and M.9256 (4.30), respectively. The highest population was recorded on genotype Tenor (15.87) and Kawa Terma (4.95). The results show that the most resistant variety against cutworm (Agrotis ipsilon) was KWS. 9212 and Trebyx while the most susceptible varieties were Tenor and Kawa Terma.

The ANOVA (Appendix) for population dynamics of cutworm on ten sugar beet varieties showed significant F. value for both the time interval and varieties (P>0.05).

4.1.5Grasshopper (Chrotogonus trachyptrus (Blanch))

Table 5 in summarized form, shows the lowest population dynamics of Grasshopper (Chrotogonus trachyptrus) on KWS. 9212 (4.82), followed by M.9256 (10.63), SM. 1890 (11.31) and Trebyx (11.38), respectively. Statistical analysis shows that the population dynamics was 11.77 (M. 9255), 11.88 (SM. 1395/Atlanta) and 12.05 (Kawa Terma).

The highest population dynamics was recorded on genotype Tenor (21.06) and Mezzano AU Poly (13.30). The result shows that the most resistant variety against Grosshopper (Chrotogonus trachyptrus) was KWS. 9212 followed by KWS. 9271 while Tenor and Mezzano AU Poly were the most susceptible varieties.

The ANOVA (Appendix) for population dynamics of Grasshopper (Chrotogonus trachyptrus) on ten sugar beet varieties showed significant. F. value for both the time interval and the varieties ($P<0.05$).

4.1.6Semilooper (Anomis sabulifera (Guenee))

Table 6 in summarized form, showed that the lowest population dynamics of Semilooper (Diachrysia orichalcae) on KWS. 9212 was 3.71, which was significant with Kawa Terma (4.25), followed by KWS. 9271 (5.53), M. 9256 and SM. 1395/Atlanta (6.08), while the highest population was recorded on Tenor (21.64), followed by SM. 1890 (9.55) and Trebyx (9.54).

These results shows that the most resistant variety against Semilooper (Diachrysia orichalcae) was KWS. 9212, followed by Kawa Terma, while the more susceptible varieties were Tenor and SM. 1890. Almost in all cases the interaction of time interval with various varieties was found to be non-significant. ANOVA has been presented in the Appendix.

4.2.Root yield of various varieties

Table 7 in summarized form shows that the yield of all the ten varieties was found to be non-significant. The highest yield was recorded in SM. 1395/Atlanta (89.53), followed by Trebyx (92.89), tenor (82.81), M. 9255 (82.50), SM. 1890 (80.47), Mezzano AU Poly 80,26), M. 9256 (79.09) and KWS. 9272 (78.33). While the lowest yield was found in Kawa Terma (77.02) followed by KWS. 9212 (78.10).

4.3 Quality analysis of ten sugar beet varieties

Table 8 in summarized form shows that all the varieties were found to be highly significant with each other. The highest purity was recorded in to be highly significant with each other. The highest purity was recorded in Trebyx (81.65) which was followed by KWS. 81.27), Kawa Terma (80.82), SM. 1395/Atlanta (80.56) and KWS. 9271 (79.78), while the lowest purity was recorded in SM. 1890 i.e. 79.03, M. 9255 (79.16), M. 9256 (79.67) and Mezzano AU Poly (79.68). The results showed that Trebyx is the best variety based on Brix %, Pol % and Purity %.

DISCUSSION

To evaluate the comparative resistance of ten sugar beet varieties against various insects pests, an experiment was conducted at Sugar Crops Research Institute (SCRI), Mardan during 2009-2010. Randomized Complete Block Design (RCBD) was used for the analysis of variance and the means were then subjected to LSD test.

Among the ten varieties tested for the population dynamics, check (Kawa Terma) was found to be the most resistant one as the lowest aphid population was recorded on it followed by KWS. 9212. The population build up of armyworm was lowest on KWS. 9212 and highest on the Tenor which showed that KWS. 9212 should be grown to avoid armyworm build up in the sugar beet crop. Almost similar results were obtained for budworm and cutworm. Both pests were less severe on KWS. 9212 and the lowest population were recoded on KWS. 9212. It again evaluated KWS 9212 as the most tolerant variety against budworm and cutworm. KWS 9212 again resulted on the lowest grasshopper population while Tenor and Mezzano AU Poly were the worst varieties in terms of resistance. The population dynamics of semilooper was the highest on SM. 1395/Atlanta and lowest on the KWS 9212 as the most resistant variety.

Yield and quality of sugar beet were also investigated to determine insect pests and their impact upon them. It was found that the best yielding varieits were SM. 1395/Atlanta and KWS 9212. The highest quality were recorded for Trebyx which was followed by KWS 9212. The most resistant varieity KWS 9212 also performed very well on the yield and quality front. Yield was highest for KWS 9212 because of less insect population and the plant was able to store more food and nutrients in the roots, thereby increasing the yield. The same logic may be applied to quality.

These findings are compatible with those of Fedorenko (1987) and Summers and Newton (1989). From the above discussion it may be concluded that KWS 9212 was the most resistant sugar beet variety as it resulted in the lowest aphid, armyworm, budwarm, cutworm, grasshopper and semilooper population. These results are in confimity with those of Bichuk, (1986), Radin (1987), Ghadiri (1990), Hurej, (1990), and Shahid (1987).

Little information is available about population dynamics and the total losses caused by these insects in some crops but no information is available in case of sugar beet.

Table1.Population dynamics of Aphids (*Aphis fabae* (Scop)) on different observations date

	Varieties	24.12.2009	08.01.2010	23.1.2010	23.02.2010	10.03.2010	23.03.2010	Mean
1	Kawa Terma	2.75 e	5.50 ef	2.50 de	3.50 ef	12.00 cd	9.50 b	3.96 d
2	M.9256	5.00 b	16.75 b	15.75 a	48.25 a	22.75 bcd	17.25 b	20.96 a
3	Mezzano AU Poly	4.50 bc	13.50 bc	9.75 b	14.25 c	28.00 bc	23.50 b	15.58 abc
4	M.9255	2.75 e	8.50 de	5.75 cde	8.00 de	14.75 cd	8.50 b	8.04 cd
5	SM.1890	3.50 cde	8.25 de	5.75 cde	3.75 ef	14.25 cd	8.50 b	7.33 cd
6	SM.1395/Atlanta	3.00 de	11.25 cd	8.50 bc	28.75 b	11.00 d	7.50 b	11.67 bcd
7	KWS.9271	4.00 bcd	6.00 ef	3.00 de	3.50 ef	35.00 b	27.25 b	13.13 abcd
8	KWS.9212	3.75 cde	3.25 f	2.25 e	1.75 f	8.50 d	16.75 b	6.04 d
9	Trebyx	3.75 cde	6.75 ef	6.00 cd	3.75 ef	16.25 cd	4.75 b	6.88 cd
10	Tenor	7.25 a	35.25 a	8.50 bc	11.25 cd	331.0 a	229.8 a	19.72 ab
	LSD for varieties =	1.23	4.43	3.59	4.65	16.6	4.59	8.836

Figures in the same column followed by different letters are significantly different from one another at 5% level of probability.

Table 2. Population dynamics of Armyworm (Spodoptera spp.) on different observation date

	Varieties	09.04.2010	24.04.2010	09.05.2010	Mean
1	Kawa Terma	5.80 cd	4.55 b	9.12 b	6.490 b
2	M.9256	8.30 bc	5.40 b	8.72 b	7.473 b
3	Mezzano AU Poly	6.62 bc	5.80 b	8.72 b	4.047 b
4	M.9255	8.30 bc	5.80 b	7.47 b	7.198 b
5	SM.1890	9.97 b	5.80 b	9.12 b	8.897 b
6	SM.1395/Atlanta	2.47 de	2.87 b	9.55 b	4.963 b
7	KWS.9271	4.95 cd	4.55 b	7.87 b	5.790 b
8	KWS.9212	1.22 e	3.32 b	4.97 b	3.170 b
9	Trebyx	7.05 bc	4.97 b	6.22 b	6.080 b
10	Tenor	15.82 a	10.80 a	37.47 a	21.36 a
	LSD for varieties =	3.704	3.08	5.36	7.266

Figures in the same column followed by different letters are significantly different from one another at 5% level of probability.

Table 3. Population dynamics of Budworm (*Helicoverpa armigera* (Hubner)) on different observations date

	Varieties	24.12.2009	23.01.2010	08.02.2010	23.02.2010	10.03.2010	25.03.2010	09.4.2010	24.04.2010	09.05.2010	Mean
1	Kawa Terma	7.02 cd	1.65 cde	0.82 c	3.30 bc	4.97 cde	5.80 c	0.80 e	0.80 cd	0.80 b	2.884 cd
2	M.9256	11.20 b	4.72 bc	0.40 c	5.37 b	4.87 bc	9.12 b	2.45 cd	3.30 bc	2.07 b	5.056 b
3	Mezzano AU Poly	5.40 de	6.20 ab	0.40 c	4.97 bc	7.05 bcd	7.45 bc	2.87 cd	0.40 d	1.65 b	4.043 bc
4	M.9255	5.12 de	0.80 de	1.25 c	4.12 bc	3.72 e	6.62 bc	2.48 cd	0.40 d	0.82 b	2.703 cd
5	SM.1890	2.47 ef	2.87 cd	0.82 c	4.97 bc	6.62 bcde	5.80 c	2.05 cde	1.70 bcd	2.50 b	3.311 bcd
6	SM.1395/Atlanta	8.72 bc	2.05 cde	1.65 bc	5.37 b	5.80 bcde	5.40 c	4.57 ab	2.87 abc	2.87 b	4.367 bc
7	KWS.9271	4.12 de	2.07 cde	8.25 a	2.45 cd	8.30 b	7.05 bc	3.30 bc	2.45 abcd	2.45 b	4.493 bc
8	KWS.9212	0.80 f	0.00 e	0.00 c	0.40 d	4.13 de	4.55 c	2.22 cde	0.40 d	0.40 b	1.432 d
9	Trebyx	6.22 cd	2.05 cde	3.72 b	3.72 bc	5.37 bcde	6.22 bc	1.62 de	1.63 bcd	2.90 b	3.716 bc
10	Tenor	17.88 a	7.87 a	8.72 a	11.63 a	16.65 a	22.05 a	4.97 a	4.12 a	7.90 a	11.31 a
	LSD for varieties =	3.27	2.79	2.10	2.78	3.07	3.08	1.62	2.38	2.52	1.90

Figures in the same column followed by different letters are significantly different from one another at 5% level of probability.

Table 4. Population dynamics of Cutworm (*Agrotis ipsilon* (Hfn)) on different observations date

	Varieties	10.03.2010	25.03.2010	09.04.2010	24.04.2010	09.05.2010	Mean
1	Kawa Terma	2.45 b	5.80 cd	2.87 abc	6.22 b	7.45 b	4.958 b
2	M.9256	3.30 b	5.80 cd	0.40 bc	5.37 bc	6.65 bc	4.304 bc
3	Mezzano AU Poly	5.40 b	8.70 bc	1.22 bc	3.30 bc	4.95 bcd	4.714 bc
4	M.9255	2.05 b	7.47 bc	3.30 ab	2.87 c	4.95 bcd	4.128 bc
5	SM.1890	3.37 b	9.12 b	0.82 bc	2.87 c	5.80 bcd	4.396 bc
6	SM.1395/Atlanta	1.65 b	7.05 bcd	1.62 bc	4.55 bc	4.95 bcd	3.964 bc
7	KWS.9271	4.55 b	7.05 bcd	2.90 abc	2.87 c	3.30 d	4.134 bc
8	KWS.9212	1.65 b	1.62 e	0.00 c	3.30 bc	4.12 cd	2.138 c
9	Trebyx	4.52 b	4.12 de	1.22 bc	3.30 bc	5.77 bcd	3.786 bc
10	Tenor	14.98 a	22.88 a	5.80 a	18.03 a	17.05 a	15.87 a
	LSD for varieties =	3.97	2.95	3.07	3.03	3.23	2.609

Figures in the same column followed by different letters are significantly different from one another at 5% level of probability.

Table 5. Population dynamics of Grasshopper (*Chrotogonus trachyptrus* (Blanch)) on different observations date

	Varieties	09.11.2009	24.11.2009	09.04.2010	24.04.2010	09.05.2010	Mean
1	Kawa Terma	10.38 bc	19.13 bc	8.30 abc	8.72 bc	13.73 b	12.05 b
2	M.9256	13.30 b	19.52 bc	4.95 de	4.97 de	10.40 bc	10.63 b
3	Mezzano AU Poly	17.05 b	20.38 b	7.05 bcd	8.72 bc	13.30 b	13.30 b
4	M.9255	14.98 b	14.13 c	7.47 bcd	9.15 b	13.10 b	11.77 b
5	SM.1890	4.15 b	20.83 b	5.37 cde	9.97 ab	16.23 b	11.31 b
6	SM.1395/Atlanta	11.20 bc	21.23 b	6.22 cde	7.05 cd	13.70 b	11.88 b
7	KWS.9271	13.30 b	7.48 b	9.97 ab	7.05 cd	10.27 bc	9.61 b
8	KWS.9212	4.12 c	6.22 d	3.30 e	4.15 e	6.43 c	4.84 c
9	Trebyx	11.63 bc	15.80 bc	6.62 cd	8.30 bc	14.55 d	11.38 b
10	Tenor	27.88 a	27.48 a	11.23 a	12.05 a	26.65 a	21.06 a
	LSD for varieties =	47.661	6.142	3.172	2.086	6.572	4.41

Figures in the same column followed by different letters are significantly different from one another at 5% level of probability.

Table 6. Population dynamics of Semilooper (*Anomis sobuliferu* (Guenee)) on different observations date

	Varieties	09.04.2010	24.04.2010	09.05.2010	Mean
1	Kawa Terma	4.12 de	4.95 c	3.70 c	4.257 d
2	M.9256	7.05 bcde	6.22 c	4.52 c	5.930 cd
3	Mezzano AU Poly	9.55 bc	7.05 c	4.95 c	7.183 bc
4	M.9255	7.90 bcd	7.05 c	7.05 bc	7.333 bc
5	SM.1890	10.80 b	11.65 d	6.22 bc	9.57 b
6	SM.1395/Atlanta	6.22 cde	4.97 c	7.05 bc	6.080 cd
7	KWS.9271	4.97 de	5.40 c	6.22 bc	5.530 cd
8	KWS.9212	3.30 e	3.30 c	4.55 c	3.717 d
9	Trebyx	7.45 bcd	11.63 b	9.55 b	9.543 b
10	Tenor	20.38 a	21.23 a	23.30 a	21.64 a
	LSD for varieties =	4.10	4.51	4.05	2.785

Figures in the same column followed by different letters are significantly different from one another at 5% level of probability.

Table 7. Root yield of sugar beet varieties

	Varieties	Yield (tons/ ha)
1	Kawa Terma	77.02
2	M.9256	79.09
3	Mezzano AU Poly	80.26
4	M.9255	82.50
5	SM.1890	80.47
6	SM.1395/Atlanta	89.53
7	KWS.9271	78.33
8	KWS.9212	78.10
9	Trebyx	82.89
10	Tenor	88.81
	LSD for varieties =	8.86 NS

NS = Non Significant

Table 8. Quality analysis of ten sugar beet varieties

	Varieties	Wt. of beet (kg/ sample)	Brix (%)	Pol (%)	Purity (%)
1	Kawa Terma	2.12 cd	18.50 a	14.71 abc	80.82 ab
2	M.9256	2.00 d	18.23 ab	14.51 bc	79.67 bcd
3	Mezzano AU Poly	2.64 ab	18.02 ab	14.27 c	79.68 bcd
4	M.9255	2.16 cd	16.65 c	13.12 d	79.16 d
5	SM.1890	2.44 abc	16.94 c	13.44 d	79.03 d
6	SM.1395/Atlanta	2.51 abc	18.08 ab	14.63 abc	80.56 abc
7	KWS.9271	2.66 ab	17.74 b	14.33 c	79.78 bcd
8	KWS.9212	2.38 bcd	18.31 ab	14.94 ab	81.27 a
9	Trebyx	2.83 a	18.55 a	15.10 a	81.65 a
10	Tenor	2.32 bcd	17.89 ab	14.55 abc	79.64 cd
	LSD for varieties =	0.4180	0.7167	0.5563	1.166

Figures in the same column followed by different letters are significantly different from one another at 5% level of probability.

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