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Rating of some Early Maturing Soybean Varieties for Whitefly Responses and its Population Trends in Autumn and Spring Seasons

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ABSTRACT

Nine early maturing soybean varieties were sown in the experimental area of Oilseed Programme, National Agricultural Research Center, Islamabad in autumn 1998 and spring 1999. The data on whitefly population was recorded for eight weeks in autumn 1998 and ten weeks in spring 1999. In autumn 98, the population of whitefly greatly fluctuated due to rains while in spring 99, a constant increase in the population of whitefly on almost all the varieties was observed. The whiteflies were usually found on the upper leaves of soybean and no or very little population was seen on the lower and middle leaves. During autumn 98, SWAT-84 proved to be the most susceptible with an average seasonal population of 0.50 whiteflies per leaf. In spring 99, WILLIAMS-82 was found to be the most susceptible variety with an average seasonal population of 0.65 whiteflies per leaf. SOY-97 was observed as the most resistant against whitefly during both the seasons with an average seasonal population of 0.26 and 0.17 whiteflies per leaf in autumn 98 and spring 99, respectively. Some differences in the crop growth in autumn and spring seasons were also recorded. In autumn 98, CENTURY-84 had the lowest number of nodes (18.0) while NARC-III had the lowest height (60.0cm). While in spring 99, HARPER had the lowest number of nodes (11.8) with the lowest height (38.8 cm). WILLIAMS-82 had the maximum number of nodes and height during both the seasons.

Key Words: Whitefly; *Bemisia tabaci;* Population; Resistance; Soybean; Growth

INTRODUCTION

Pakistan is facing a serious shortage of edible oils. Its domestic production is hardly meeting 30% of the total requirements (Aslam *et al*., 1995-96). The requirement of edible oils for 1996-97 was 1.6 million tonnes, of which 0.583 million tonnes (33%) came from local production and the remaining 1.02 million tonnes (67%) was imported at a cost of US$ 612 million (Economic Survey, 1997-98). The annual increase in consumption of edible oil is 9% and the total requirement is expected to reach two million tonnes by the year 2000 (Economic Survey, 1997-98). About 70% of our local production comes from the cotton seeds, 21% both from rapeseed and mustard and the remaining from all other crops including soybean, sesame, sunflower, safflower and maize. Soybean is one of the nonconventional oilseed crops which can be grown in the country during both the spring and autumn seasons. Thus, it has the great potential to narrow the gap between domestic production and consumption of edible oil by increasing the area under its cultivation. At present, it is grown over an area of 6882.59 hectares with a production of 8.5 thousand tonnes (Economic Survey, 1997-98).

Cotton whitefly (*Bemisia tabaci*: Gennadius), is one of the serious pests of soybean and causes damage to leaves both by sucking and transmitting yellow mosaic virus (Nene, 1972; Bhattacharya & Rathore, 1977). Noor *et al.* (1995) reported that whitefly attacks on soybean crop both in spring and autumn season but its population varies during both the seasons. Considerable differences in the whitefly population were observed on different soybean cultivars (Kundu *et al*., 1995; Lambert *et al*., 1995, 1997). In Pakistan information on the seasonal abundance of whiteflies on soybean is still lacking. This information is valueable to the successful production and protection of soybean. The present studies were, therefore, designed to observe the population trend of whitefly on soybean during autumn and spring seasons and to rate the different soybean cultivars for resistance against whitefly.

MATERIALS AND METHODS

The present studies were conducted in the experimental area of Oilseed Programme, National Agricultural Research Centre, Islamabad during autumn 1998 and spring 1999. Nine early maturing soybean varieties were sown on 23rd July, 1998 and again on 14 February, 1999. The varieties were sown in a RCBD and replicated thrice. The plot size in both the seasons was 5 m x1.8 m. The detals of the varieties is as follows: V1 = CENTURY-84; V2 = CUMBERLAND; V3 =

WILLIAMS-82; V4 = NARC-111; V5 = NARC-IV; V6 = SOY-97; V7 = NARC-V; V8 = SWAT-84; V9 = HARPER

The data on whitefly population and plant growth was recorded from middle of August to the end of October in 1998 and from last week of April to the 1st week of July in 1999. For recording whitefly population, 10 plants were selected randomly from each treatment and population of whitefly adults was counted from lower, middle and upper leaves of each plant after Noor *et al*. (1995) This data was transformed and analysed statistically and Duncan's Multiple Range test was applied on varieties to compare them. The data on plant growth *viz*. number of notes and plant hight was recorded weekly by selecting five plants from each variety and their averages were taken.

RESULTS AND DISCUSSION

The results of the experiments conducted in autumn 1998 and spring 1999 are reported below.

Experiment No.1. Some early maturing varieties of soybean were sown and data on whitefly population, plant height and number of nodes was recorded for eight weeks. The statistical analysis revealed that the varieties differed significantly from each other (Table I). These

Table I. Mean whitefly population per leaf on nine varieties of during autumn season*

Variety	Transformed means	Original means
SWAT-84	1.37A	0.50 A
NARC-IV	1.35AB	0.48 AB
CUMBERLAND	1.33AB	0.48 AB
NARC-V	1.32ABC	0.42 ABC
CENTURY-84	1.31ABC	0.41 ABC
WILLIAMS-82	1.30BCD	0.39 BCD
NARC-III	1.29BCD	0.36 ECD
HARPER	1.27CDE	0.33 CDE
SOY-97	1.22E	0.26 E

* Column means followed by the same letter are not significantly different

results are not conformity to those of Singh *et al*. (1995) who reported non-significant differences in whitefly population among different varieties of soybean. SWAT-84 was statistically similar to NARC-IV, CUMBERLAND, NARC-V and CENTURY-84. However, SWAT-84 differed significantly from WILLIAMS-82, NARC-III HARPER, FS-85 and SOY-97. SOY-97, the least infested variety did not differ significantly from FS-85 and Harper.

The results on weekly per leaf population of whitefly are given in Fig. 1A. In the first week of observation, the maximum population of 0.64 whiteflies

Fig. 1A. Weekly per leaf population density of *Bemisia tabaci* on nine varieties of soybean

af on nine

riginal means
65A
64A
41B
34BC
30CD
27D
26D
24DE
17E

antly different

per leaf was recorded on NARC-IV. It was followed by CUMBERLAND with a population of 0.62 per leaf. The lowest population of 0.35 whiteflies per leaf was recorded on FS-85 followed by 0.41 whiteflies per leaf on SOY-97. In the next week an increase in population was observed on all the varieties. The maximum number, 1.4 whiteflies per leaf, was noted on CUMBERLAND while SOY-97 was the least susceptible with 0.56 whiteflies per leaf. The population build up of whitefly was negatively affected by the heavy splashes of rains in 3rd and 4th weeks of observations. SWAT-84 proved to be the most susceptible with 0.73 and 0.28 whiteflies per leaf during the 3rd and 4th weeks of observations, respectively. While CUMBERLAND with 0.25 whiteflies per leaf and CENTURY-84 with 0.06 whiteflies per leaf showed least infestation during this period, respectively. During 5th week, a pronounced increase in whitefly population was recorded on all the varieties except on SOY-97, HARPER and FS-85. The maximum population of 0.83 whiteflies per leaf was noted on CUMBERLAND and minimum of 0.12 per leaf on FS-85. Although, there were no rains during the 6th week but no increase in whitefly population was seen on all the varieties. The earlier decrease in whitefly population on these varieties was a result of their earlier maturity and the population went on decreasing because of the dryness of their leaves. During 7th and 8th weeks, whitefly population decreased in all the varieties and the maximum population of 0.23 whiteflies per leaf on CUMBERLAND and 0.08 per leaf on SWAT-84 was observed. The minimum population was recorded on SOY-97 during this period which was 0.05 and 0.01 whiteflies per leaf, respectively. The leaves of all the varieties had almost dried by the 8th week of observation, therefore, no population was found soybean afterwards. The population ranged from 0.01 to 1.4

whiteflies per leaf during these 8 weeks of observations. This result is in agreement to that of Nadeem (1984) who also reported little attack of whitefly on soybean ranging from 0.00 to 1.27 whiteflies per leaf during his eight weeks of observations.

The results on average seasonal per leaf population

Table II. Average plant height (cm) and number of nodes per plant in nine varieties of soybean during autumn season

Varieties		Weeks							
		W1	W2	W3	W4	W5	W6	W7	W8
VI	Nodes	5.6	9.6	10.2	12.4	12.8	15.6	17.5	18.0
	Height	21.8	30.5	38.3	43.6	48.8	55.5	68.0	72.5
V2	Nodes	6.5	9.4	12.3	13.8	14.8	15.6	16.4	18.2
	Height	31.8	40.4	43.5	49.6	55.4	56.4	58.0	60.5
V3	Nodes	5.8	9.6	14.4	16.6	17.0	18.2	21.2	23.6
	Height	35.5	43.3	44.5	57.8	66.2	70.6	76.6	80.3
V4	Nodes	7.5	9.2	10.3	12.6	14.6	16.6	19.0	21.6
	Height	36.5	4.5	43.0	48.5	51.8	54.3	58.4	60.0
V5	Nodes	7.9	10.2	11.2	12.3	13.1	13.8	17.5	19.8
	Height	24.2	27.5	34.0	45.4	51.4	53.0	56.5	60.1
V6	Nodes	7.8	9.6	11.3	14.2	14.8	16.0	17.6	19.4
	Height	29.3	32.6	40.5	45.2	56.6	61.5	65.0	69.5
V7	Nodes	7.6	9.4	10.3	12.2	14.4	16.25	16.6	19.3
	Height	33.5	40.2	44.5	48.8	61.0	64.5	72.6	78.0
V8	Nodes	5.6	8.8	12.2	14.2	16.3	17.6	19.5	19.7
	Height	27.5	38.6	44.4	51.5	60.4	6.35	68.4	71.2
V9	Nodes	7.9	10.6	11.5	13.0	16.6	17.3	18.0	19.3

are given in Fig.1B. It is clear that SWAT-84 was the most susceptible variety with an average seasonal population of 0.50 whiteflies per leaf. It was followed by CUMBERLAND and NARC-IV, both with 0.48 whiteflies per leaf. These results are not in agreement to those of Turhan *et al*. (1983) who recorded WILLIAMS-82 as the most susceptible variety against insect pests. SOY-97 proved to be most resistant variety with 0.26 whiteflies per leaf. The second most resistant variety was FS-85. It attracted an average number of 0.31 whiteflies per leaf.

The lowest number of nodes (5.6 per plant) was

Fig. 1B. Average seasonal per leaf population of *Bemisia tabaci*

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Table IV. Average plant height (cm) and number of nodes per plant in nine verities of soybean during spring season

Varieties		Weeks									
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10
V1	Nodes	10.6	12.5	13.4	13.8	15.2	15.9	16.2	16.5	16.8	17.0
	Height	31.0	36.4	39.5	44.6	50.5	55.6	60.0	62.5	64.5	68.0
V2	Nodes	7.5	9.4	12.5	13.2	14.2	15.5	15.8	16.6	17.2	17.5
	Height	28.4	32.5	38.6	42.2	45.6	54.4	60.5	67.6	70.2	74.0
V3	Nodes	9.8	10.2	11.4	12.5	14.6	15.2	15.6	15.1	16.4	16.5
	Height	32.2	35.5	40.6	46.5	50.4	53.5	55.2	58.4	60.2	60.8
V4	Nodes	6.8	7.2	9.4	9.8	10.5	12.5	12.8	13.5	14.6	15.8
	Height	25.5	32.6	38.4	44.6	46.0	50.2	54.8	56.4	57.0	58.5
V5	Nodes	7.2	8.2	8.9	9.5	11.5	12.4	12.9	13.5	13.8	14.4
	Height	29.5	34.6	38.5	40.6	46.4	50.5	54.6	58.0	59.5	61.3
V6	Nodes	9.5	11.4	12.8	14.5	15.6	16.4	16.9	17.5	17.9	18.2
	Height	30.2	34.5	38.6	42.5	46.5	49.4	53.5	58.4	60.2	63.5
V7	Nodes	8.2	10.2	11.5	12.2	13.2	13.9	14.6	15.4	16.2	16.9
	Height	25.6	30.4	35.6	39.5	42.4	45.6	50.3	55.2	58.4	60.2
V8	Nodes	6.8	6.9	7.2	7.9	8.5	9.2	9.6	10.5	11.2	11.8
	Height	22.0	26.5	28.6	32.5	33.4	35.5	37.2	37.9	38.4	38.8
V9	Nodes	6.6	8.5	10.4	11.2	12.9	14.6	16.5	17.8	18.5	19.5

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population revealed that the varieties differed significantly from each other (Table III). WILLIAMS-82 and NARC-IV did not differ significantly from each other but differed significantly from all other varieties. NARC-III and NARC-V were statistically alike with each other but were different from all other varieties except Century-84 which was at par with NARC-V. CENTURY-84 was statistically similar with CUMBERLAND, SWAT-84 and HARPER. SOY-97 showed significant differences from all other varieties except HARPER. These results are in agreement with those of Lambert *et al*. (1995) who reported significant differences in whitefly population among different varieties of soybean. However, these are not in line with those of Singh *et al*. (1988) who found non-significant differences among various cultivars of soybean for their resistance against whitefly. The presence of whitefly on

Fig. 2A. Weekly per leaf population density of *Bemisia tabaci on nine varieties of soybean*

while all other varieties did not have any population on them.During 1st week of observation, the population of whitefly was very low on all the varieties. During this period, the maximum population (0.18 per leaf) was recorded on WILLIAMS-82. During the next 2 weeks, population increased in all the varieties and maximum population of 0.48 and 0.53 whiteflies per leaf was recorded on WILLIAMS-82 in 2nd and 3rd weeks, respectively. The minimum population of 0.04 and 0.15 whiteflies per leaf was recorded on SOY-97 in this period, respectively. During the 4th week, the maximum population of 0.75 whiteflies per leaf was counted on HARPER (V8) and was also the maximum population on this variety during the entire period of observations. The minimum population (0.28 whiteflies per leaf) in the 4th week was recorded on CUMBERLAND. On WILLIAMS-82, 0.62 whiteflies per leaf were recorded during this period. In the 5th week, the maximum population (1.78 whiteflies per leaf) was recorded on WILLIAMS-82 and this was also the highest population on this variety during entire period of observation. After 5th week, the population of whitefly went on decreasing on WILLIAMS-82.

The minimum population (0.31 whiteflies per leaf) was recorded on CUMBERLAND during this period. The highest population in most varieties was observed during the early days of June, 1999 (6th week of observations). These findings are in line with those of Noor *et al*. (1995) who reported highest per leaf population of whitefly on soybean in the 2nd week of June, 1993. The maximum population of 1.24 whiteflies per leaf was recorded on NARC-IV and the minimum of 0.25 per leaf on HARPER during this period of observation. The population of 1.04 whiteflies per leaf was recorded both on CENTURY-84 and NARC-III during this week and this was the highest population on these two varieties during entire period of observation. In the 7th week of observation, the population of whitefly declined on all the varieties except in NARC-IV and NARC-V and the highest population of the crop season (1.75 whiteflies per leaf) was recorded on NARC-IV during this period. The minimum population of 0.22 whiteflies per leaf was observed both on SOY-97 and HARPER during this period of observation. In the 8th week, NARC-IV again proved to be the most susceptible variety with the maximum population of 1.04 whiteflies per leaf. The 2nd highest population (0.52 whiteflies per leaf) was recorded on WILLIAMS-82. In the 9th week, the highest population (0.31 whiteflies per leaf) was recorded on NARC-III followed by 0.30 whiteflies per leaf on WILLIAMS-82. In this week, whiteflies were not observed on CENTURY-84, SWAT-84 and HARPER because of the dryness of leaves on these varieties. In the 10th week, the maximum population of 0.24 whiteflies per leaf was again observed on NARC-III followed by WILLIAMS-82 and NARC-IV with 0.1 and 0.04 whiteflies per leaf, respectively.

The average seasonal population of whitefly on soybean varieties revealed that WILLIAMS-82 was the most susceptible variety with a population of 0.65 whiteflies per leaf. The results are in agreement to those of Turhan *et al.* (1983) who recorded WILLIAMS-82 as the most susceptible variety against insect pests. However, the results are not in confirmity with those of Nadeem (1984) who recorded WILLIAMS-82 as more resistant to whitefly than other varieties. The next susceptible variety was NARC-IV with an average seasonal population of 0.64 whiteflies per leaf. SOY-97 proved to be the most resistant variety against whitefly with an average seasonal population of 0.17 whiteflies per leaf and was followed by HARPER with an average seasonal population of 0.24 whiteflies per leaf. These results are presented in Fig. 2B.

During the first week of observations, NARC-III attained maximum height (32.2 cm) with 9.8 nodes per plant (Table IV). But maximum number of nodes (11.6 per plant) were counted on CENTURY-84 with 31 cm height. WILLIAMS-82 attained least height (21.2 cm) with minimum number of nodes (6.6 per plant) during this period. In the following weeks, the maximum and minimum number of nodes and their respective heights were recorded in different varieties. In the last week, WILLIAMS-82 had the maximum height (90.5 cm) with maximum number of nodes per plant (19.5). This variety also attracted the maximum number of whiteflies. It was followed by CUMBERLAND which

Fig. 2B. Average seasonal per leaf population of *Bemisia tabaci*

attained a maximum height of 54 cm with 17.5 nodes per plant. The lowest height (38.8 cm) was recorded in HARPER with 11.8 nodes per plant. This was also the lowest number of nodes per plant in this week.

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