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Studies on the Relative Resistance of Some Soybean Varieties Against Whitefly and its Population Fluctuations During the Crop Season

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Abstract: Twenty three varieties of soybean were sown in two experiments in the experimental area of Oilseed Programme, National Agricultural Research Centre, Islamabad in a randomized complete block design. The experimental unit was 6 × 1,8 m. The varieties in Experiment No.1 attained maturity in ten weeks while they took eight weeks in Experiment No. 2. The whitefly population was usually observed on the upper fresh leaves of soybean whereas no or very little whitefly population was observed on the lower and middle leaves of the plant. Heavy rains proved to be lethal for whitefly and a sharp decline in its population was recorded after rains. The significant differences were recorded in the whitefly population amongst the varieties in both the experiments. The susceptibility and resistance of different varieties against whitefly varied in different weeks. In the first week, CO-1 proved to be most resistant in Experiment No.1, while G-9956 showed maximum resistance to whitefly in the 2nd and 3rd weeks. As a whole, AGS-129 was the most susceptible variety with an average seasonal population of 0.74 whiteflies per leaf in Experiment No.1 while G-9956 proved to be most resistant with an average seasonal population of 0.19 whiteflies per leaf. Among the 11 varieties sown in Experiment No. 2. RAWAL-1 was recorded as the most susceptible variety with an average seasonal population of 1.08 whiteflies per leaf. AGS-344 proved to be most resistant with an average seasonal population of 0.10 whiteflies per leaf. The data on plant growth revealed no direct relation between number of nodes per plant and their respective plant heights. A plant having more number of nodes may have less height and vice versa. Similarly, a plant having maximum number of nodes or height in the initial stages of growth may not have maximum number of nodes or height at maturity.

Key words: Whitefly, *Bemisia tabaci*, population, resistance, soybean, growth

Introduction

Soybean, *Glycine max* (Linnaeus) is a crop of temperate regions and has a wide range of adaptability. It is well adapted to latitude zero to more than 50 degree north (Howell and Caldwell, 1980). Environmental factors affect the branching habits of soybean, therefore, the time taken by different cultivars to reach maturity can be varied in various ecological zones (Quresh *et al.*, 1983). The present commercial cultivars grown in Pakistan were introduced in the early 1980s from USA for experimental purposes. Its cultivation on a commercial scale was reported in 1970-71 in NWFP, 1975-76 in Sindh, 1983 in Punjab and is still in the experimental stages in Balochistan (Hattam and Abbasi, 1994).

The profuse foliage of soybean attracts a large number of insect pests and the damage begins with the sowing of seed and continues until harvest. It is attacked by more than 200 species of insects (Gangrade, 1976; Bhattacharya and Rathore, 1977). Chaudhry (1982) and Arain (1983) reported that field crickets, green weevil, armyworm, cutworm, thrips, jassid, whitefly, mites and leaf eating beetles caused heavy economic losses to this crop. Turhan *et al.* (1983) reported whitefly, *Bemisia tabaci* as the most important pest of soybean. The population of whitefly is greatly affected by the heavy rains and every heavy rain, more than 10 mm, brings a sharp decline in its population densities (Khalifa and El-Khidir, 1964). El-khidir (1965) also reported that whiteflies breed rapidly from September to the middle of November and then their numbers declined. Lambert *et al.* (1995), Kundu *et al.* (1995) and Lambert *et al.* (1997) reported significant differences to whitefly population among different soybean cultivars. The present studies were designed to observe the population fluctuations in whitefly population and to evaluate the

resistance/susceptibility among various varieties of soybean.

Materials and Methods

The present studies were conducted in the experimental area of Oilseed Programme, National Agricultural Research Centre, Islamabad, during autumn 1998. 22 varieties of soybean were sown in 2 different experiments in a randomized complete block design with 3 replications on 23rd July, 1998. The experimental unit in both experiments was 5 × 1.8 m. The details of the experiments are as follows:

Experiment No. 1

G-9956	AGS-19	AGS-73
AGS-129	AGS-314	AGS-327
IAC-100	CO31	GC 04040-27-1
GC 86017-170-IN	GC-86018.427-3	UFV-2

Experiment No. 2

AGS-344	AGS-345	AGS-346
AGS-347	AGS-348	AGS-349
AGS-350	AGS-334	AGS-335
AGS-292	RAWAL-I	

The data on whitefly population and plant growth was recorded from middle of August to the end of October. The whitefly population was recorded from 10 randomly selected plants in each treatment and it was counted from lower, middle and upper leaves of each plant after Noor *et al.* (1995). This data was transformed and analysed statistically. Then Duncan's Multiple Range test was applied on varieties to compare them. The data on plant growth viz; number of nodes and plant height was recorded weekly by selecting 5 plants

randomly from each variety. Then their averages were taken.

Results and Discussion

Experiment No. 1

Twelve soybean varieties were sown and data on whitefly population, number of nodes and plant heights was recorded for 10 weeks. The results are presented in Table 1 and 2. The statistical analysis of the data on whitefly population

Table 1: Mean whitefly population per leaf on 12 varieties of soybean

Variety	Transformed means	Original means
.AGS-129	1.45 A	0.74 A
.AGS-73	1.38 AB	0.59 AB
.LIFV-2	1.34 BC	0.49 BC
.IAC-100	1.27 CD	0.33 CD
.Gr. 66013-427-3	1.24 CD	0.27 CD
.AGS 314	1.24 CD	0.27 CD
.00.1	1.24 CD	0.27 CD
.Gc B40402)-1	1.23 CD	0.26 CD
.AGS-19	1.22 D	0.25 D
.AGS-327	1.20 D	0.23 D
.Gr: 96017-170-IN	1.20 D	0.23 D
.G-9956	1.18 S	0.19 ID

*Column means followed by the same letter are not significantly different by Duncan's multiple range test (P=0.05)

revealed that the varieties differed significantly from each other (Table 1). The results are in line with those of Lambert *et al.* (1995) who reported significant differences among different cultivars of soybean for their resistance against whitefly. Among the 12 varieties viz; 0-9956, AGS-19, AGS-73, AGS129, AGS-314, AGS-327, IAC-100, CO-1, Go 84040-27-1, Go 86017-170-1N, Go 86019-427-3 and UFV-2; AGS-129 and AGS 73 were statistically similar with each other. AGS-73 was also at par with UFV-2 but different significantly from all other varieties. The remaining nine varieties i.e. IAC-100, GC 86 0 18-42 7-3, AGS-314, CO-1 AGS-19, AGS-327, GC 06017-170-IN and G-9956 did not differ significantly from each other.

During first 2 weeks of observations, AGS-129 showed maximum susceptibility to whitefly with a population of 0.64 and 1.76 whiteflies per leaf, respectively. While during 3rd week maximum population of 0.8 whiteflies per leaf was recorded on UFV-2. In the first week, CO-1 proved to be least infested with whitefly with a population of 0.18 whiteflies per leaf while in the 2nd and 3rd weeks, 0-9956 showed maximum resistance against whitefly with a population of 0.46 and 0.16 whiteflies per leaf, respectively. A sharp decline in the population of whitefly was recorded on all the varieties because of heavy rains in early September. These observations are not in agreement to those of McPherson and Lambert (1995) who reported highest population of whitefly in soybean in early September. During this period the highest population of 0.11 whiteflies per leaf was recorded on AGS-129 and the lowest of 0.01 per leaf on GC-134040-27-1. In the 5th week, the population of whitefly increased in all the varieties and the maximum population of 1.26 per leaf was observed on AGS-73 followed by 1.14 whiteflies per leaf on AGS-129. The lowest population of 0.23 whiteflies per leaf was counted on CO.1 during this period and was followed by 0.25 whiteflies per leaf on 0-9956. After the 5th week, the population built up was recorded on all the varieties except in AGS-73, GC-94040-271 and GC-96017170-IN. It was mainly because of the earlier dryness of the leaves in these varieties. The highest population of whitefly, 1.41 per leaf was recorded on AGS-129 and the lowest, (0.35 per leaf) on GC-84040-271 in the 6th week of observations. In all the varieties, the population went on decreasing after the 6th week. No population was observed on AGS-314, AGS-327 and GC86017-170-IN during the 9th week of observation while some population was recorded on others. In the last week of observation, the highest population, 0.08 whiteflies per leaf, was recorded both on AGS-129 and IAC-100. The weekly fluctuations in the population of whitefly on different soybean varieties revealed that the highest population during the entire period of observations was recorded on AGS-129 in the last

Table 2: Average plant height 1st-el and number of nodes per plant in 12 varieties of soybean

Varieties	Weeks	1	2	3	4	5	6	7	8	14	10
0-99b6	Nodes	5.9	8.6	11.5	12.2	16.8	17.6	18.2	19.2	19.3	20.2
	Height	25.0	35.4	43.6	48.2	55.6	62.4	68.5	73.5	76.4	78.5
AGS 19	Nodes	5.5	9.4	12.2	14.2	15.0	16.3	18.2	19.7	21.3	21.5
	Height	20.2	30.5	41.6	55.5	60.4	65.5	72.6	76.5	79.2	81.6
AGS-13	Nodes	7.2	10.8	12.3	14.5	15.8	17.3	18.2	16.9	19.9	20.5
	Height	30.5	43.4	48.6	53.4	60.5	67.5	72.4	75.5	76.4	79.2
AGS-129	Nodes	4.8	6.5	10.2	12.5	13.8	16.0	18.6	18.8	19.2	20.3
	Height	16.6	23.5	30.2	37.4	40.6	45.9	50.4	54.6	59.5	61.4
AGS 314	Nodes	4.5	8.2	40.8	13.6	13.9	15.2	15.8	16.6	17.5	18.2
	Height	19.5	27.4	31.5	39.4	44.5	49.5	51.6	55.4	58.3	59.5
AGS-327	Nodes	5.3	9.2	10.8	12.6	13.5	14.8	19.3	16.2	18.4	19.5
	Height	35.0	44.8	51.6	64.6	69.6	72.6	75.5	77.4	81.8	83.2
IAC-100	Nodes	4.6	6.8	0.9	10.4	15.2	16.9	18.2	19.5	20.8	20.8
	Height	20.5	32.6	39.6	45.5	53.4	80.2	67.5	73.4	76.4	76.8
CO. I	Nodes	5.9	7.4	11.0	13.8	15.8	17.3	10.9	20.5	20.9	21.2
	Height	31.0	37.5	45.4	52.6	60.3	65.3	68.4	70.2	72.4	72.5
Gs 84040 27 1	Nodes	13.5	10.2	12.5	13.2	13.9	15.2	16.9	17.3	18.4	18.9
	Height	20.2	35.5	42.6	53.8	55.6	50.4	67.4	70.2	73.5	75.2
Gc 66017-170-IN	Nodes	5.5	9.8	10.4	12.0	13.8	15.0	16.9	17.2	17.6	18.2
	Height	25.4	32.6	38.8	45.8	46.4	51.5	59.4	61.4	62.6	62.9
GC 86018-427-3	Nodes	6.2	6.5	12.6	15.8	16.6	18.4	20.5	21.5	22.2	23.2
	Height	31.0	39.4	51.8	59.5	65.4	70.5	78.4	83.4	813.6	91.6
UFV-2	Nodes	4.8	6.9	9.2	11.5	13.2	15.8	15.9	16.4	17.2	17.9
	Height	25.6	32.4	40.6	49.4	55.6	60.2	61.4	65.5	65.2	67.4

week of August 1998 These findings are not in conformity to those of Noor *et al.* (1995) who recorded the maximum population of 3.5 whiteflies per leaf, on soybean in the 3rd week of September.

The data on number of nodes and plant heights revealed that during 1st week, the lowest number of nodes per plant were recorded on AGS-314 with an average height of 29.5 cm. However, the lowest average height was measured on AGS129 with 4.8 nodes per plant. On the other hand, AGS-327 attained a maximum height of 35 cm with 5.3 nodes per plant in this period. While the maximum average number of nodes, 7.2 per plant, were recorded on AGS-73 with 30.5 cm average height. In all in other weeks, the maximum and minimum number of nodes and their respective plant heights varied in different varieties. In the last week of observation, when the crop was almost matured and had attained maximum growth, the maximum average height of plant 91.6 cm was measured on GC- 86016-427-3 with 23.2 nodes per plant and this is also the maximum number of nodes per plant as compared to all other varieties. While the minimum height, 59.5 cm was of AGS-314 with 18.2 nodes per plant. However, the minimum number of nodes were counted on UFV-2 which attained 67.4 cm height in this period. The number of nodes per plant and their respective heights in all other varieties were found intermediate between these 2 extremes, These results are given in Table 2.

Table 3: Mean whitefly population per leaf on 11 varieties of soybean*

Variety	Transformed means	Original means
RAWAL-1	1.55 A	1.08 A
GS-349	1.43 AB	0.79 B
AGS-347	1.36 BC	0.60 BC
4GS-346	1.34 BCD	0.47 BCD
AGS-335	1.31 BCD	0.46 BCD
AGS-345	1.26 CDE	0.35 CDE
AGS-292	1.24 CDE	0.30 CDE
AGS-348	1.21 DE	0.25 DE
AGS-350	1.15 E	0.15 E
AGS.334	1.13 E	0.14 E
AGS-344	1.11 E	0.10 E

*Column, means followed by the same letter are not significantly different by Duncan's multiple range test (p = 0.05)

Experiment No. 2

Eleven varieties of soybean were sown and the data on whitefly population, plant heights and number of nodes was recorded for 8 weeks and results are given in Table 3 and 4. The statistical analysis of the data on whitefly population revealed significant differences among the varieties (Table 3). These findings are in agreement to those of Lambert *et al.* (1997) who reported significant differences in whitefly population among 14 genotypes of soybean, RAWAL-1 differed statistically from all other varieties except AGS-349, AGS-349 was also statistically at par with AGS-347, AGS-346 and AGS-335 while it differed significantly from all other varieties. AGS-347 was found statistically similar not only with AGS-349 but also with AGS-346, AGS-335, AGS-345 and AGS-292. AGS-344 was statistically at par with AGS-314, AGS-350, AGS-348, AGS-292 and AGS-345, however, it differed significantly from the remaining 5 varieties.

The weekly population trend of whitefly showed that the maximum population (1.1 per leaf) during the 1st week of observations was recorded on AGS-349 while in the 2nd week maximum population of 2.5 whiteflies per leaf was recorded on RAWAL-1. AGS-334 proved to be least infested with whitefly during the 1st and 2nd weeks of observation with a population of 0.15 and 0.27 per leaf. In all other weeks, RAWAL-1 was found to be the most infested with whitefly. The lowest population varied among various varieties during different weeks. The population decreased in all the varieties in early September because of heavy rains. It again increased in all the varieties during middle of September. The population again decreased afterwards in all the varieties except in AGS-345 and RAWAL-1. It may be due to the earlier dryness of leaves in these varieties. The earlier decrease in the population of whitefly on soybean in this period was not in agreement to these of El-Khidir (1965) who recorded that whiteflies breed rapidly from September to middle of November and then their number declined. In the 7th week, whiteflies were not found on AGS-350 and AGS-334 while very low population was observed in others. By the 8th week, the crop had almost matured and leaves on all the varieties either fallen or dried.

Table 4: Average plant height (cm) and number of nodes per plant in 11 varieties of soybean

Varieties	Weeks	W1	W2	W3	W4	W5	W6	W7	W8
AGS-344	Nodes	6.4	10.0	10.6	11.0	11.5	12.4	14.0	14.2
	Height	25.8	40.4	46.4	48.6	50.6	63.6	58.5	60.3
AGS 345	Nodes	8.0	10.6	11.5	12.0	12.9	13.6	15.0	16.4
	Height	35.4	43.8	51.4	55.0	57.5	60.2	62.2	65.5
A65-346	Nodes	5.8	9.4	12.4	13.5	15.0	15.8	16.9	17.2
	Height	25.5	38.4	53.4	58.5	62.4	66.6	70.5	75.5
AG5-347	Nodes	6.2	8.9	10.2	10.6	12.5	13.0	13.2	14.0
	Height	33.5	39.6	43.8	45.0	48.5	50.5	57.2	61.6
AGS-348	Nodes	7.2	9.2	10.4	11.2	12.0	12.8	13.3	15.0
	Height	30.2	35.5	38.6	45.5	49.8	52.5	57.5	62.2
AGS- 349	Nodes	5.9	7.6	10.8	12.7	15.2	17.5	19.4	21.5
	Height	25.5	32.4	43.4	50.5	56.2	57.8	62.4	66.0
AGS-350	Nodes	4.8	6.2	10.4	12.0	12.5	14.2	14.9	15.2
	Height	30.4	38.5	43.6	49.4	54.6	56.5	58.0	60.2
AGS-334	Nodes	5.2	8.5	9.6	10.0	12.5	13.8	14.2	14.9
	Height	20.6	25.4	38.6	14.4	45.2	52.6	55.5	59.2
AGS-335	Nodes	6.5	9.6	11.0	12.8	14.2	16.6	20.5	22.2
	Height	31.5	39.4	42.8	49.5	55.3	60.4	65.3	68.5
AGS-292	Nodes	5.2	9.5	11.0	11.9	13.8	16.4	18.2	19.5
	Height	21.6	32.4	34.9	38.0	43.4	49.5	52.5	55.2
RAWAL-1	Nodes	7.5	11.0	13.8	15.5	17.5	20.6	21.6	22.4
	Height	20.9	29.4	35.6	42.2	50.4	61.5	64.3	69.5

Therefore, the population was not seen on any variety except RAWAL-1 where the population was 0.16 whiteflies per leaf. RAWAL-1 proved to be the most susceptible variety with 1.08 whiteflies per leaf followed by AGS-349 with 0.79 whiteflies per leaf. The lowest whitefly population of 0.10 per leaf was counted on AGS-344 followed by 0.14 per leaf on AGS-334. During first week, the maximum number of nodes (8) with f Itaxlinu in height f35.4 cm) were recorded on AGS-345. The least plant height (20.6 cm) was recorded on AGS-334 with 5.2 nodes per plant during this period. In the following weeks, increase in the plant height and number of nodes was observed. However, the maximum number of nodes and maximum plant heights varied among different varieties. In the 8th week of observation, when the crop had almost matured, AGS-292 attained the lowest plant height of 55.2 cm with 19.5 nodes per plant. However, the minimum nodes, 14, were counted on AGS-347 with 61.6 cm plant height. RAWAL-1 not only attracted maximum population of whitefly but also attained the maximum number of nodes (21.5 per plant) with 69.5 cm plant height. However, AGS-346 attained the maximum height of 75.5 cm per plant with 17.2 nodes per plant. These results are given in Table 4.

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