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Effect of sowing time and varieties on incidence of insect pests of soybean

RK Kalyan and OP Ameta

Abstract

An experiment was conducted to study the effect of sowing time and varieties on incidence of insect pests of soybean. The crop sown during 1st week (timely sown) of July had significantly higher incidence of *Bemisia tabaci* and *Oberopsis brevis* as compare to crop sown in the 3rd week (late sown) of July. The incidence of *Chrysodeixis acuta*, *Helicoverpa armigera* and *Spodoptera litura* significantly lower in timely sown as compared to late sown. Among test varieties, significant lowest incidence of *B. tabaci* and *S. litura* was recorded in soybean variety of RKS-24 while, the significant lowest incidence of *C. acuta*, *H. armigera* and *O. brevis* was observed in the JS-95-60. In case of yield, the significantly highest yield with mean of 1564 and 1650 kg ha⁻¹ was recorded in timely sown crop. Among the varieties, significantly highest seed yield of 1840 and 1812 kg ha⁻¹ was recorded in RKS-24.

Keywords: Effect, insect pests, soybean, sowing time and varieties

Introduction

Soybean is the largest source of vegetable oil and protein in the world ^[1]. Globally, soybean grown over an area of 118.00 million ha with a production of 315.46 metric ton having productivity of 2670 kg ha⁻¹^[2]. At present, the USA, Brazil and China are the 'Big-3' in soybean production, with the hegemony of USA. India ranks 4th in area and 5th in production of soybean in the world after USA, Brazil, Argentina and China ^[3]. The contribution of India in world soybean area and production is about 9.22 and 3.30 per cent, respectively. In Rajasthan, soybean is cultivated in an area of 0.682 million hectare, with the production of 0.563 lakh MT with a productivity of 827 kg ha⁻¹^[4]. During the late sixties and early seventies, the soybean crop was considered to be comparatively safe crop as regards to insect pest attack ^[5,6]. However, over 99 insect species attacking soybean crop but now the situation has changed and as many as 275 insect species have been recorded attacking soybean crop in India ^[7]. Researchers in many parts of India have confirmed that seed yield and seed quality are being adversely affected by major insect pests *viz.* girdle beetle, tobacco caterpillar, green semilooper, gram pod borer, jassids and white fly^[8]. It is essential to find out varieties which are resistant to insect pests and optimum sowing times where crop can escape damage of insect pests and offer excellent opportunity for the development such technology for pest management. Therefore, the present study was conducted to study the effect of sowing time and varieties on incidence of insect pests of soybean.

2. Material and Methods

An experiment was conducted at Agricultural Research Station-Banswara (Rajasthan) during *kharij*-2012 and 2013 to study the effect of sowing times and varieties on incidence of insect pests of soybean. The experiment was laid out with two date of sowings and six varieties in factorial RBD. Crop was sown during first (timely sowing) and third (late sowing) week of July, 2012 and 2013, respectively. Six varieties of soybean *viz.* JS-335, JS-93-05, JS-95-60, Pratap Soya-1, Pratap Soya-2 and RKS-24 were sown on each date mentioned above in 3 × 4 m plots. The sowing dates were considered as main plot whereas; the varieties were consider as sub plots. All recommended agronomic practices were followed as per the package of practice (Zone IVb) to raise the good crop except insecticidal sprays. The observations were recorded at weekly interval after germination of the crop on five randomly selected tagged plants till harvest by physical count of insects during morning hours between 8.0. to 10.0 a.m. While, in case of girdle beetle, the infested twigs were counted. The data obtained was subjected to analysis of variance (factorial RBD).

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3. Results and Discussions

3.1 Effect of sowing times on the incidence of insect pests

The data recorded on incidence of major insect pests viz. whiteflies (*Bemisia tabac*), semilooper (*Chrysodeixis acuta*), girdle beetle (*Obereopsis brevis*), gram pod borer (*Helicoverpa armigera*) and tobacco caterpillar (*Spodoptera litura*) in different sowing dates are presented in Table 1-5 revealed that the sowing time had the significant effect on the incidence of insect pests in soybean.

During the year 2012, the mean population of white fly in the crop sown in the first week of July (timely sown) was 8.24/5 plants, which was significantly higher than the mean population of 7.67/5 plants in the crop sown in third week of July (late sown). During the year 2013 the mean population of white fly in the crop sown in first week of July (timely sown) was 8.86/5 plants as compared to 6.68/5 plants in the crop sown in third week of July (Table 1). The data recorded on the incidence of semilooper in the soybean are presented in Table 2. The results revealed that soybean crop sown in the first week of July the incidence of semilooper was significantly lower than the crop sown in 3rd week of July. The mean populations of semilooper in the crop sown in the first week of July and third week of July were 4.27 and 4.92; 4.72 and 5.38/5 plants during the year 2012 and 2013, respectively.

The data recorded during the year 2012, on the incidence of girdle beetle is presented in Table 3. The data showed that mean damaged twigs of girdle beetle in the crop sown in first week of July (Timely sown) was 2.26/5 plants, which was significantly higher than the mean damaged twigs of 1.11/5 plants in the crop sown in third week of July (Late sown). Similarly, the mean damaged twigs of girdle beetle in the crop sown in first week of July was 4.60/5 plants was significantly higher than the mean damaged twigs of 2.56/5 plants in the crop sown in third week of July during the year 2013 (Table 3).

The data recorded on the incidence of gram pod borer larvae in soybean sown in the first and third week of July are presented in Table 4. The data revealed that soybean crop sown in the first week of July the incidence of gram pod borer was significantly lower than the late sown crop (third week of July) during both the years of experiment. The mean populations of gram pod borer recorded in the crop sown in the first week and third week of July were 0.60 and 0.72; 0.46 and 0.57/5 plants during the year 2012 and 2013, respectively (Table 4). The higher population has affected the yield adversely.

During the year 2012, the data recorded on the incidence of tobacco caterpillar in the soybean are presented in Table 5. The mean population of tobacco caterpillar in the crop sown in first week of July (timely sown) was 4.64/5 plants, which was significantly lower with the mean population of 5.42/5 plants in the crop sown in third week of July (late sown). Similarly, during the year 2013 the mean population of tobacco caterpillar in the crop sown in first week of July was 6.01/5 plants, which was significantly lower with the mean population of 6.37/5 plants in the crop sown in third week of July (Table 5) which affected the seed yield directly.

The present study findings are in close conformity with findings of earlier workers^[9] who reported that early sown soybean had higher incidence of girdle beetle than late sown. The lowest pest incidence and higher yield was recorded in early sowing (20th June to 5th July)^[10]. The populations of *Biloba subsecivella* (Zuller), *Chrysodeixis acuta* (Walker), *S. litura* and *S. obliqua* (Walker) was recorded low in early-

sown soybeans^[11]. Whereas, pod borer damage was low in early sown crop during June^[12]. While, incidence of girdle beetle was more in early sown crop. Early sown crop recorded lower incidence of *S. litura*, *Thysanoplusia orichalcea* and *Spilosoma oblique* compared to late sown crop^[13].

3.2 Effect of varieties on the incidence of insect pests

In the present investigation the seasonal mean incidence of white fly indicated that significant lowest incidence of white fly with the mean of 5.51 and 5.20 whiteflies/5 plants was recorded in the RKS-24 during the year 2012 and 2013, respectively. It was followed by JS-95-60, JS-93-05, JS-335 and Pratap Soya-1. While, the highest incidence of white fly with the mean of 10.09 and 7.62 whiteflies/5 plants was recorded in the Pratap Soya-2 variety of soybean during the year 2012 and 2013, respectively (Table 1).

In the present investigation the significantly lowest incidence of semilooper with the mean population of 3.99 and 3.85 larvae /5 plants was recorded in the JS-95-60 variety of soybean during the year 2012 and 2013, respectively. It was followed by RKS-24, JS-93-05, Pratap Soya-2 and Pratap Soya-1. While, highest incidence of semilooper with the mean of 5.10 and 5.91/5 plants was recorded in the JS-335 variety of soybean during the year 2012 and 2013, respectively (Table 2). Similarly, lowest incidence of girdle beetle with the mean of 1.31 and 3.23 damaged twigs/5 plants was recorded in the JS-95-60 variety of soybean during the year 2012 and 2013, respectively. It was followed by RKS-24, JS-93-05, Pratap Soya-1 and Pratap Soya-2. While, highest incidence of girdle beetle with the mean of 1.91 and 3.93 damaged twigs /5 plants was recorded in the JS-335 variety of soybean during the year 2012 and 2013, respectively (Table 3). The significant lowest incidence of gram pod borer with the seasonal mean of 0.51 and 0.36 larvae/5 plants was recorded in the JS-95-60 variety of soybean during the year 2012 and 2013, respectively. It was followed by RKS-24, JS-335, JS-93-05 and Pratap Soya-1. While, highest incidence of gram pod borer with the mean of 0.75 and 0.66 larvae /5 plants was recorded in the Pratap Soya-2 variety of soybean during the year 2012 and 2013, respectively (Table 4). In the present investigation significant lowest incidence of tobacco caterpillar with the mean of 3.59 and 5.06 larva/5 plants was recorded in the RKS-24 variety of soybean during the year 2012 and 2013, respectively. It was followed by JS-95-60, Pratap Soya-2, Pratap Soya-1 and JS-93-05. However, highest incidence of tobacco caterpillar with the mean of 6.39 and 6.95 larva/5 plants was recorded in the JS-335 during the year 2012 and 2013, respectively (Table 5).

In the present investigation, varieties screened against insect pests are new; hence, very meagre information is available. However, the results obtained in the present investigation are in close agreement with the earlier workers who reported that JS-80-21, P-1 (IS) and JS-335 exhibited the least preference by girdle beetle^[14]. Soybean variety JS-93-05 had multiple insect resistances against soybean pest complex^[15]. JS-335 as least preferred variety by green semilooper and Pratap Soya was least preferred by girdle beetle^[16]. Bragg was found least preferred by tobacco caterpillar while MAUS-81, MAUS-47 and Pratap soya were found most preferred^[17]. Varieties Pratap soya, JS-71-05 and MAUS-47 had maximum population of green semilooper and were more preferred while Indra soya-9, NRC-37 and JS-335 were found least preferred by this pest. JS-335 and Monetta was found highly susceptible against defoliators^[13]. Soybean varieties, MAUS-47, NRC-12 and JS-71-05 were found most preferred

varieties. NRC-37, NRC-12, JS-335 and Bragg were found moderately preferred whereas MAUS-47, MAUS-81 and JS-93-05 were found most preferred and had highest per cent infestation of girdle beetle^[18].

3.3 Effect on seed yield

The data recorded on the effect of sowing dates and varieties revealed that the date of sowing and varieties had significant effect on the seed yield of soybean (Table 6). The significantly highest yield with mean of 1564 and 1650 kg ha⁻¹ was recorded in case of soybean crop sown during the first week of July as against the mean seed yield of 1429 and 1451 kg ha⁻¹ recorded in case of crop sown during the third week of July in the year 2012 and 2013, respectively. Among the varieties, the highest seed yield of 1840 kg ha⁻¹ was recorded in RKS-24 which was significantly higher than remaining varieties. It was followed by JS-335 with the seed yield of

1694 kg ha⁻¹ in JS-335. The lowest yield of 1302 kg ha⁻¹ was recorded in Pratap Soya-2 during the year 2012. Similarly, during the year 2013 the highest mean seed yield of 1902 kg ha⁻¹ was recorded in RKS-24 which was at par with JS-335 which yielded 1812 kg ha⁻¹. The lowest yield of 1315 kg ha⁻¹ was recorded in Pratap Soya-2.

In the present investigation, the results obtained are in close agreement with the earlier workers who recorded lowest pest incidence and higher yield in timely sowing (20th June to 5th July)^[10]. Delay in the sowing of soybean resulted decrease in yields^[19]. The pod borer damage was recorded low in early sown crop during June^[12] and maximum grain yield was recorded in early and timely sown soybean^[20, 21]. Early sown crop recorded lower incidence of *S. litura*, *Thysanoplusia orichalcea* and *Spilosoma oblique* compared to late sown crop^[13].

Table 1: Interaction effect of sowing dates and varieties on the infestation of white fly, *Bemisia tabaci* in soybean during 2012 and 2013

Varieties	2012				2013			
	1 st Sowing	2 nd Sowing	Total	Mean	1 st Sowing	2 nd Sowing	Total	Mean
JS-335	3.05 (8.83)	2.94 (8.17)	6.00 (17.00)	3.00 (8.50)	2.76 (7.10)	2.75 (7.08)	5.51 (14.18)	2.75* (7.09)
JS-93-05	2.88 (7.80)	2.75 (7.08)	5.63 (14.88)	2.82 (7.44)	2.75 (7.08)	2.71 (6.87)	5.47 (13.95)	2.73 (6.98)
JS-95-60	2.73 (6.93)	2.65 (6.50)	5.37 (13.43)	2.69 (6.72)	2.60 (6.20)	2.58 (6.15)	5.16 (12.33)	2.58 (6.17)
RKS-24	2.53 (5.88)	2.37 (5.14)	4.90 (11.02)	2.45 (5.51)	2.40 (5.25)	2.37 (5.14)	4.77 (10.39)	2.39 (5.20)
Pratap Soya-1	3.19 (9.69)	3.12 (9.21)	6.31 (18.90)	3.15 (9.45)	2.87 (7.71)	2.81 (7.38)	5.67 (15.09)	2.83 (7.55)
Pratap Soya-2	3.28 (10.28)	3.22 (9.90)	6.51 (20.18)	3.25 (10.09)	2.88 (7.80)	2.82 (7.44)	5.70 (15.24)	2.85 (7.62)
Total	17.66 (49.41)	17.06 (46.00)			16.26 (41.14)	16.04 (40.06)		
Mean	2.94 (8.24)	2.84 (7.67)			2.71 (8.86)	2.67 (6.68)		
S. Em.±	S		0.13				0.011	
	V		0.023				0.010	
CD at 5%	S		0.39				NS	
	V		0.067				0.030	

* Square root transformations values and figures in parenthesis are retransformed values

Table 2: Interaction effect of sowing dates and varieties on the infestation of semilooper, *C. acuta* in soybean during 2012 and 2013

Varieties	2012				2013			
	1 st Sowing	2 nd Sowing	Total	Mean	1 st Sowing	2 nd Sowing	Total	Mean
JS-335	2.27 (4.65)	2.46 (5.55)	4.73 (10.20)	2.36 (5.10)	2.45 (5.52)	2.61 (6.30)	5.06 (11.82)	2.53* (5.91)
JS-93-05	2.17 (4.20)	2.31 (4.83)	4.48 (9.03)	2.24 (4.52)	2.22 (4.41)	2.37 (5.13)	4.59 (9.54)	2.29 (4.77)
JS-95-60	2.06 (3.75)	2.17 (4.23)	4.24 (7.98)	2.12 (3.99)	2.05 (3.69)	2.12 (4.00)	4.17 (7.69)	2.08 (3.85)
RKS-24	2.11 (3.96)	2.15 (4.11)	4.26 (8.07)	2.13 (4.04)	2.19 (4.32)	2.39 (5.19)	4.58 (9.51)	2.29 (4.76)
Pratap Soya-1	2.26 (4.62)	2.42 (5.37)	4.69 (9.99)	2.34 (5.00)	2.44 (5.46)	2.52 (5.85)	4.96 (11.31)	2.48 (5.66)
Pratap Soya-2	2.22 (4.41)	2.43 (5.40)	4.65 (9.84)	2.32 (4.92)	2.32 (4.89)	2.51 (5.82)	4.83 (10.71)	2.42 (5.36)
Total	13.09 (25.62)	13.94 (29.49)			13.67 (28.29)	14.52 (32.29)		
Mean	2.18 (4.27)	2.32 (4.92)			2.28 (4.72)	2.42 (5.38)		
S. Em.±	S		0.015				0.014	
	V		0.025				0.025	
CD at 5%	S		0.043				0.042	
	V		0.074				0.072	

* Square root transformations values and figures in parenthesis are retransformed values

Table 3: Interaction effect of sowing dates and varieties on the infestation of girdle beetle, *O. brevis* in soybean during 2012 and 2013

Varieties	2012				2013			
	1 st Sowing	2 nd Sowing	Total	Mean	1 st Sowing	2 nd Sowing	Total	Mean
JS-335	1.73 (2.50)	1.35 (1.32)	3.08 (3.82)	1.54 (1.91)	2.40 (5.25)	1.76 (2.61)	4.16 (7.86)	2.08* (3.93)
JS-93-05	1.63 (2.16)	1.27 (1.11)	2.90 (3.27)	1.45 (1.64)	2.22 (4.41)	1.79 (2.70)	4.01 (7.14)	2.00 (3.57)
JS-95-60	1.50 (1.77)	1.15 (0.84)	2.66 (2.61)	1.33 (1.31)	2.12 (4.00)	1.72 (2.46)	3.84 (6.46)	1.92 (3.23)
RKS-24	1.59 (2.04)	1.27 (1.11)	2.86 (3.15)	1.43 (1.58)	2.20 (4.35)	1.61 (2.13)	3.82 (6.48)	1.91 (3.24)
Pratap Soya-1	1.71 (2.43)	1.31 (1.23)	3.03 (3.66)	1.50 (1.83)	2.32 (4.89)	1.68 (2.31)	4.00 (7.20)	2.00 (3.60)
Pratap Soya-2	1.78 (2.67)	1.24 (1.05)	3.02 (3.72)	1.51 (1.86)	2.28 (4.68)	1.91 (3.15)	4.19 (7.83)	2.09 (3.91)
Total	9.95 (13.57)	7.59 (6.66)			13.53 (27.61)	10.47 (15.36)		
Mean	1.66 (2.26)	1.26 (1.11)			2.26 (4.60)	1.74 (2.56)		
S. Em.±	S		0.019				0.022	
	V		0.033				0.037	
CD at 5%	S		0.056				0.063	
	V		0.098				0.109	

* Square root transformations values and figures in parenthesis are retransformed values

Table 4: Interaction effect of sowing dates and varieties on the infestation of gram pod borer, *H. armigera* in soybean during 2012 and 2013

Varieties	2012				2013			
	1 st Sowing	2 nd Sowing	Total	Mean	1 st Sowing	2 nd Sowing	Total	Mean
JS-335	1.05 (0.60)	1.09 (0.69)	2.14 (1.29)	1.07 (0.65)	0.96 (0.42)	1.00 (0.51)	1.96 (0.93)	0.98* (0.47)
JS-93-05	1.05 (0.60)	1.12 (0.75)	2.17 (1.35)	1.08 (0.68)	1.00 (0.51)	1.05 (0.60)	2.05 (1.11)	1.03 (0.56)
JS-95-60	0.99 (0.48)	1.02 (0.54)	2.01 (1.02)	1.00 (0.51)	0.89 (0.30)	0.96 (0.42)	1.85 (0.72)	0.93 (0.36)
RKS-24	0.97 (0.45)	1.13 (0.78)	2.11 (1.23)	1.05 (0.62)	0.93 (0.36)	1.00 (0.51)	1.93 (0.87)	0.97 (0.44)
Pratap Soya-1	1.10 (0.72)	1.12 (0.75)	2.22 (1.47)	1.11 (0.74)	1.06 (0.63)	1.00 (0.51)	2.06 (1.14)	1.03 (0.56)
Pratap Soya-2	1.10 (0.72)	1.13 (0.78)	2.24 (1.50)	1.12 (0.75)	1.03 (0.57)	1.12 (0.75)	2.15 (1.32)	1.08 (0.66)
Total	6.27 (3.57)	6.61 (4.29)			5.86 (2.74)	6.20 (3.42)		
Mean	1.05 (0.60)	1.10 (0.72)			0.98 (0.46)	1.03 (0.57)		
S. Em.±	S		0.004				0.003	
	V		0.006				0.005	
CD at 5%	S		0.011				0.008	
	V		0.018				0.015	

* Square root transformations values and figures in parenthesis are retransformed values

Table 5: Interaction effect of sowing dates and varieties on the infestation of tobacco caterpillar, *S. litura* in soybean during 2012 and 2013

Varieties	2012				2013			
	1 st Sowing	2 nd Sowing	Total	Mean	1 st Sowing	2 nd Sowing	Total	Mean
JS-335	2.58 (6.18)	2.66 (6.60)	5.25 (12.78)	2.62 (6.39)	2.69 (6.75)	2.76 (7.14)	5.46 (13.89)	2.73* (6.95)
JS-93-05	2.40 (5.28)	2.55 (6.03)	4.96 (11.31)	2.48 (5.66)	2.65 (6.52)	2.70 (6.81)	5.35 (13.33)	2.68 (6.67)
JS-95-60	2.11 (3.96)	2.47 (5.58)	4.58 (9.54)	2.29 (4.77)	2.42 (5.37)	2.50 (5.76)	4.92 (11.13)	2.46 (5.57)
RKS-24	1.96 (3.33)	2.08 (3.84)	4.04 (7.17)	2.02 (3.59)	2.32 (4.89)	2.39 (5.22)	4.71 (10.11)	2.36 (5.06)
Pratap Soya-1	2.25 (4.56)	2.42 (5.34)	4.67 (9.90)	2.33 (4.95)	2.57 (6.12)	2.70 (6.78)	5.27 (12.90)	2.64 (6.45)
Pratap Soya-2	2.24 (4.54)	2.37 (5.13)	4.62 (9.67)	2.31 (4.84)	2.62 (6.39)	2.65 (6.51)	5.27 (12.90)	2.63 (6.41)
Total	13.55 (27.85)	14.55 (32.52)			15.28 (36.04)	15.70 (38.22)		
Mean	2.26 (4.64)	2.43 (5.42)			2.55 (6.01)	2.62 (6.37)		
S. Em.±	S		0.014				0.014	
	V		0.025				0.025	
CD at 5%	S		0.042				0.042	
	V		0.072				0.073	

* Square root transformations values and figures in parenthesis are retransformed values

Table 6: Effect of date of sowing and varieties on the seed yield (kg ha⁻¹) of soybean during 2012 and 2013

Varieties	2012				2013			
	1 st Sowing	2 nd Sowing	Total	Mean	1 st Sowing	2 nd Sowing	Total	Mean
JS-335	1749	1638	3388	1694	1902	1722	3624	1812
JS-93-05	1444	1312	2756	1378	1506	1347	2853	1427
JS-95-60	1541	1347	2888	1444	1666	1361	3027	1513
RKS-24	1916	1763	3679	1840	2006	1798	3804	1902
Pratap Soya-1	1381	1263	2645	1322	1409	1256	2666	1333
Pratap Soya-2	1354	1250	2603	1302	1409	1222	2631	1315
Total	9385	8573			9899	8705		
Mean	1564	1429			1650	1451		
S. Em.±	S		21.90				24.40	
	V		38.00				42.26	
CD at 5%	S		54				60	
	V		93				103	

4. Conclusion

The results of present study revealed that the timely sown soybean crop had significantly higher incidence of *Bemisia tabaci* and *Obereopsis brevis* as compare to late sown. Whereas, the incidence of *Chrysodeixis acuta*, *Helicoverpa armigera* and *Spodoptera litura* significantly lower in timely sown as compared to late sown. Among varieties, the lowest incidence of whitefly and tobacco caterpillar was recorded in RKS-24 while; the significant lowest incidence of *C. acuta*, *H. armigera* and *O. brevis* was observed in the JS-95-60. The significantly highest yield was also recorded in timely sown crop.

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