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Study on application of urea with insecticides as drenching against white grub, *H. consanguinea*

Patel TM, Baraiya KP, Patil VM and Patel KR

Abstract
A field experiment comprised of fertilizer with insecticides tested against white grub on groundnut was conducted in endemic area of Junagadh District at Oil Seed Research Station, Manavadar. The fertilizers with chemical treatment have maximum reduction of plant mortality and grub population. Treatment combination of $S_1P_1F_2$ (S_1: imidacloprid 40% + fipronil 40% - 80 WG @ 50 g per ha, F_2: urea 50 kg/ha, P_1: Chlorpyriphos 20% EC @ 4 lit/ha) maximum reduction of plant mortality than the S_0, P_0 and F_0 (S_0**:** No Seed treatment, P_0: No pesticide application, F_0: No application of urea) and grub population with high yield can be taken. NICBR point of view, the highest found in S_1: imidacloprid 40% + fipronil 40% - 80 WG @ 50 g per ha (1:1.70) and high fertilizer dose (F_2: urea 50 kg/ha) (1:64). When treatment combination of $S_1P_1F_2$ was significantly superior to the other treatments combination and highest NICBR was found (1:1.77). Result indicated that higher doses of fertilizer with combination of seed treatment and pesticide suppressed the grub population and yield is increases than the single insecticide treatment.

Keywords: Chlorpyriphos, grub population, white grub, and urea

Introduction
Groundnut, *Arachis hypogea* L. is a major contributor to the total oilseed production of the country. Number of pests attack groundnut causing severe economic loss to farmers. The term white grub or root grub is applied to immature stage of beetles popularly known as cochafers and chafers beetle. The different insect pests infesting this crop in Saurashtra region of Gujarat state, white grub, *Holotrichia consanguinea* is considered as key soil dwelling insect. Yadava and Sharman (1995) [5], reported that the presence of one grub/m2 may cause 80-100 per cent plant mortality. Adult collection and insecticidal applications are the major tactics of management followed against all the white grub species (Raodeo *et al*. 1976) [3]. In India out of 171 species of white grub, 12 are of major importance and 14 are of major importance for Gujarat state (Kapadia *et al*., 2006) [2]. They are polyphagous in nature. Considering the farmer facts, more emphasis is now being laid on use of chemical pesticide with fertilizer (urea) as one of the important components of control strategies. Proper utilization of safer insecticides and fertilizer can help to overcome the existing environment problem. So, Insecticide and fertilizers combination was made to test the efficacy against white grub in groundnut crop.

Materials and Methods
Field experiments were conducted in endemic area of Junagadh District at Oil Seed Research Station, Manavadar. Study on application of urea with insecticides as drenching against white grub, *h. Consanguinea* infesting groundnut during 2017.
The experiment design for Factorial Randomized Block Design with twelve treatments and three replications, the plot size was 5.0m x 3.6m and plant spacing was 60×10cm. The crop was raised following the recommended agronomic practices except plant protection measures. The application of insecticides was done by drenching method and fertilizer (urea) was done by broadcasting method applied at the time of pest initiation. The experiment observations are recorded total number of plants and plants damaged by white grub were recorded at 30, 45, 60, 75 and 90 days after germination. The damaged plant was removed after each count. From these data, per cent plant mortality due to White grub was calculated. White grub population were recorded from one square meter are in each plot by digging soil up to 50 cm deep. The data thus obtained was analysed by $\sqrt{x+0.5}$ transformation statistical methods.

Treatments details

Seed Treatment

S_0- No Seed treatment.

S_1- Seed treatment with imidacloprid 40% + fipronil 40% (80% WG) @ 2 g/kg seed at the time of sowing.

Pesticide Treatment

P_0 – No pesticide application.

P_1 - Chlorpyriphos 20% EC @ 4 lit/ha apply at initiation of pest.

Different Nitrogen doses

F_0 – No application of urea (Nitrogen).

F_1 - Application of urea 25 kg/ha (11.5 kg N_2 / ha) @ apply at initiation of pest.

F_2 – Application of urea 50 kg/ha (23 kg N_2 / ha) @ apply at initiation of pest.

Table 1: Different Treatment and Combination factor

Treatment	Different Factor
T_1	S_0 P_0 F_0
T_2	S_0 P_0 F_1
T_3	S_0 P_0 F_2
T_4	S_0 P_1 F_0
T_5	S_0 P_1 F_1
T_6	S_0 P_1 F_2
T_7	S_1 P_0 F_0
T_8	S_1 P_0 F_1
T_9	S_1 P_0 F_2
T_{10}	S_1 P_1 F_0
T_{11}	S_1 P_1 F_1
T_{12}	S_1 P_1 F_2

Result and Discussion

The result presented in (Table-2) showed that plant mortality due to white grub in different insecticidal seed treatment and fertilizer treatment was significantly low as untreated combination plots at 30, 45, 60, 75 and 90 days after germination (DAG).

Plant mortality due to white grub individual effect of insecticides and fertilizer 30 days after germination.

Observations recorded 30 days after germination indicated (Table-2) that lowest plant mortality were observed in seed treated with (S_1: imidacloprid 40% + fipronil 40% - 80% WG @ 250 g per ha) (7.58%), pesticides treatment (P_1: chlorpyriphos 20% EC @ 4000 ml per ha) (8.58%) and effect of fertilizer on plant mortality was very low in higher fertilizer dose (F_2: urea 50 kg/ha) (9.97%) which have statistically at par with lower dose of fertilizer (F_1: urea 25 kg/ha) (11.26%). The no application of urea fertilizer (F_0) has been found higher plant mortality (14.66%). Thus overall seed treatment (S_1), pesticide application (P_1) and top dressing of urea (F_1 & F_2) found lower plant mortality due to white grub. S×P combination was not reaching the significant level. When S×F, P×F and S×P×F combination are highly significant.

45 days after germination

Observations recorded 45 days after germination indicated (Table-2) that lowest plant mortality were observed in seed treated with (S_1: imidacloprid 40% + fipronil 40% - 80% WG @ 250 g per ha) (8.12%), pesticides treatment (P_1: chlorpyriphos 20% EC @ 4000 ml per ha) (9.33%) and effect of fertilizer on plant mortality was very low in higher fertilizer dose (F_2: urea 50 kg/ha) (10.64%) which have statistically at par with lower dose of fertilizer (F_1: urea 25 kg/ha) (11.89%). The no application of urea fertilizer (F_0) has been found higher plant mortality (15.00%). Thus overall seed treatment (S_1), pesticide application (P_1) and top dressing of urea (F_1 & F_2) found lower plant mortality due to white grub. S×P combination was not significant whereas, P×F is significant. When S×F and S×P×F combination were highly significant.

60 days after germination

Observations recorded 60 days after germination indicated (Table-2) that lowest plant mortality were observed in seed treated with (S_1: imidacloprid 40% + fipronil 40% - 80% WG @ 250 g per ha) (8.36%), pesticides treatment (P_1: chlorpyriphos 20% EC @ 4000 ml per ha) (9.62%) and effect of fertilizer on plant mortality was very low in higher fertilizer dose (F_2: urea 50 kg/ha) (10.86%) which have statistically at par with lower dose of fertilizer (F_1: urea 25 kg/ha) (12.23%). The no application of urea fertilizer (F_0) has been found higher plant mortality (15.55%). Thus overall seed treatment (S_1), pesticide application (P_1) and top dressing of urea (F_1 & F_2) found lower plant mortality due to white grub. S×P combination is not significant and S×P×F is significant. When S×F and P×F combination are highly significant.

75 days after germination

Observations recorded 75 days after germination indicated (Table-2) that lowest plant mortality were observed in seed treated with (S_1: imidacloprid 40% + fipronil 40% - 80% WG @ 250 g per ha) (8.52%), pesticides treatment (P_1: chlorpyriphos 20% EC @ 4000 ml per ha) (9.92%) and effect of fertilizer on plant mortality was very low in higher fertilizer dose (F_2: urea 50 kg/ha) (11.12%) which have statistically at par with lower dose of fertilizer (F_1: urea 25 kg/ha) (12.56%). The no application of urea fertilizer (F_0) has been found higher plant mortality (15.97%). Thus overall seed treatment (S_1), pesticide application (P_1) and top dressing of urea (F_1 & F_2) found lower plant mortality due to white grub. S×P combination was not significant, S×F is high significant, P×F is significant and S×P×F is highly significant.

90 days after germination

Observations recorded 90 days after germination indicated (Table-2) that lowest plant mortality were observed in seed treated with (S_1: imidacloprid 40% + fipronil 40% - 80% WG @ 250 g per ha) (8.92%), pesticides treatment (P_1: chlorpyriphos 20% EC @ 4000 ml per ha) (10.17%) and effect of fertilizer on plant mortality was very low in higher fertilizer dose (F_2: urea 50 kg/ha) (12.02%) which have statistically at par with lower dose of fertilizer (F_1: urea 25 kg/ha) (12.75%). The no application of urea fertilizer (F_0) has been found higher plant mortality (16.62%). Thus overall seed treatment (S_1), pesticide application (P_1) and top dressing of urea (F_1 & F_2) found lower plant mortality due to white grub. S×P combination was not significant and S×P×F combination are highly significant.

Thus, it can be inferred from overall results that the S×P×F combination are highly significant and S×P×F (F_2: high fertilizer dose) combination have lowest plant mortality found it.

Table 2: Efficacy of insecticides and fertilizer (level) against white grub infesting groundnut

Different level and interaction	Plant mortality (%)					Average Number of Grub/m^2
	30 DAG*	45 DAG	60 DAG	75 DAG	90 DAG	
S_0	24.37**(17.03)	24.77(17.55)	25.15 (18.06)	25.56(18.61)	26.14(19.41)	2.30***(1.52)
S_1	15.98(7.58)	16.56(8.12)	16.80(8.36)	16.97(8.52)	17.38(8.92)	1.41(1.19)
S.Em.±	0.34	0.50	0.47	0.43	0.51	0.03
C.D. at 5%	1.01	1.47	1.37	1.25	1.50	0.08
P_0	23.04(15.32)	23.54 (15.96)	23.88(16.39)	24.17(16.76)	24.92(17.75)	2.10(1.45)
P_1	17.31(8.58)	17.78(9.33)	18.07(9.62)	18.36(9.92)	18.59(10.17)	1.57(1.25)
S.Em.±	0.34	0.50	0.47	0.43	0.51	0.03
C. D. at 5%	1.01	1.47	1.37	1.25	1.50	0.08
F_0	22.51(14.66)	22.79(15.00)	23.22(15.55)	23.55(15.97)	24.06(16.62)	2.06(1.44)
F_1	19.61(11.26)	20.17(11.89)	20.47(12.23)	20.76(12.56)	20.92(12.75)	1.77(1.33)
F_2	18.40(9.97)	19.03(10.64)	19.24(10.86)	19.48(11.12)	20.29(12.02)	1.66(1.29)
S. Em.±	0.42	0.61	0.57	0.52	0.63	0.03
C. D. at 5%	1.24	1.80	1.68	1.53	1.84	0.09
C. V. %	7.25	10.28	9.45	8.51	10.00	8.25
					S × P	
S.Em.±	0.49	0.71	0.66	0.60	0.73	0.04
C. D. at 5%	NS	NS	NS	NS	NS	NS
					S × F	
S.Em.±	0.60	0.87	0.81	0.74	0.89	0.05
C. D. at 5%	1.75	2.54	2.37	2.17	2.61	0.13
					P × F	
S.Em.±	0.60	0.87	0.81	0.74	0.89	0.05
C. D. at 5%	1.75	2.54	2.37	2.17	2.61	0.13
S. Em.±	0.84	1.23	1.14	1.05	1.26	0.06
C. D. at 5%	2.48	3.60	3.36	3.07	3.68	0.19
C. V. %	7.25	10.28	9.45	8.51	10.00	8.25

S_0: no seed treatment, S_1: imidacloprid 40% + fipronil 40% (80% WG) @ 2 g/kg, P_0: no pesticide treatment, P_1: Chlorpyriphos 20 % EC @ 4 lit/ha, F_0: no fertilizer treatment, F_1: Application of urea 25 kg/ha (11.5 kg N_2 / ha), F_2: Application of urea 50 kg/ha (23 kg N_2 / ha)

* DAG = Days after germination

** Arcsine percentage transformed value.

*** $\sqrt{X} + 0.5$ transformed values.

Figures in Parentheses are retransformed value

Grub population

Effect of various treatments on white grub population was studied by counting number of grubs from a one square meter area in each plot by digging soil up to 50 cm deep pit in each plot after harvesting of groundnut crop.

The result further indicated (Table-2) that the lowest grub population were observed in seed treated with (S1: imidacloprid 40% + fipronil 40% - 80% WG @ 250 g per ha) 1.19 meter square grub population. However, the without seed treated plots found highest grub population (1.52 grubs/m2). Similarly the individual effect of pesticides usages (P1: chlorpyriphos 20% EC @ 4000 ml per ha) having lowest grub population (1.25 grubs/m2), where without pesticide application having highest grub population (1.45 grubs/m2) of white grub. The effect of fertilizer on grub population was very low in higher fertilizer dose (F2: urea 50 kg/ha) (1.29 grubs/m2). Where, lower dose of fertilizer (F1: urea 25 kg/ha) (1.33 grubs/m2) and it was statistically at par with no application of urea fertilizer (F0) has been found higher grub population (1.44 grubs/m2). Thus, overall seed treatment (S1), pesticide application (P1) and top dressing of urea (F2) found lower grub population.

Pod yield

Result presented in (Table-3) showed that the highest yield in seed treated with (S1: imidacloprid 40% + fipronil 40% - 80% WG @ 250 g per ha) 2409 kg/ha. However, the without seed treated plots found lowest yield 1749 kg/ha. Similarly the individual effect of pesticides usages (P1: chlorpyriphos 20% EC @ 4000 ml per ha) having highest yield 2264 kg/ha, where without pesticide application having lowest yield 1893 kg/ha of groundnut. The effect of fertilizer on yield was very high in higher fertilizer dose (F2: urea 50 kg/ha) 2209 kg/ha, lower dose of fertilizer (F1: urea 25 kg/ha) 2131 kg/ha and no application of urea fertilizer (F0) having lowest yield 1893 kg/ha of groundnut has been found. Thus, overall seed treatment (S1), pesticide application (P1) and top dressing of urea (F2) found highest yield in groundnut.

Dry Fodder yield

Result presented in (Table-3) showed that the highest yield in seed treated with (S1: imidacloprid 40% + fipronil 40% - 80% WG @ 250 g per ha) 5789 kg/ha. However, the without seed treated plots found lowest yield 4805 kg/ha. Similarly the individual effect of pesticides usages (P1: chlorpyriphos 20% EC @ 4000 ml per ha) having highest 5652 kg/ha, where without pesticide application having lowest yield 4979 kg/ha of groundnut. The effect of fertilizer on yield was very high in higher fertilizer dose (F2: urea 50 kg/ha) 5564 kg/ha, lower dose of fertilizer (F1: urea 25 kg/ha) 5408 kg/ha and no application of urea fertilizer (F0) having lowest yield 4921 kg/ha of groundnut has been found. Thus, overall seed treatment (S1), pesticide application (P1) and top dressing of urea (F2) found highest yield in groundnut.

Net incremental cost benefit ratio

Further, it could be seen from the results that the highest NICBR was recorded in the yield (S1: imidacloprid 40% + fipronil 40% - 80 WG @ 50 g per ha) (1:1.70), high fertilizer dose (F2: urea 50 kg/ha) (1:64) and (P1: chlorpyriphos 20% EC @ 4000 ml per ha) (1:1.63).

Table 3: Economics of different insecticides and fertilizer (level) evaluated against white grub

Different level	Cost of Cultivation (Rs/ha)			Average Yield (Kg/ha)		Gross income (Rs/ha)			Net profit (Rs/ha)	ICBR
	Cost of insecticides and fertilizer (Rs/ha)	Common cultivation practices	Total (Rs/ha)	Pod	Dry fodder	Pod	Dry fodder	Total		
S_0	0	50000	50000	1749	4805	69968	38440.72	108408.7	58409	1:1.17
S_1	2750	50000	52750	2409	5789	96356.8	46315.92	142672.7	89923	1:1.70
P_0	0	50000	50000	1893	4979	75729.6	39834.4	115564	65564	1:1.31
P_1	1700	50000	51700	2264	5652	90569.6	45214.96	135784.6	84085	1:1.63
F_0	0	50000	50000	1897	4921	75870.8	39371.44	115242.2	65242	1:1.30
F_1	147.5	50000	50148	2131	5408	85245.6	43260.32	128505.9	78358	1:1.56
F_2	295	50000	50295	2209	5564	88370.8	44510.32	132881.1	82586	1:1.64

Note:
S_0: no seed treatment, S_1: imidacloprid 40% + fipronil 40% (80% WG) @ 2 g/kg, P_0: no pesticide treatment, P_1: Chlorpyriphos 20% EC @ 4 lit/ha, F_0: no fertilizer treatment, F_1: Application of urea 25 kg/ha (11.5 kg N_2 / ha), F_2: Application of urea 50 kg/ha (23 kg N_2 / ha).
Labour Charge: Rs. 200/Day, Price of groundnut pod: Rs. 40/kg., Price of groundnut fodder: 8/kg.
CHLORPYRIPHOS 20% EC: Rs. 300/1litre, IMIDACLOPRID + FIPRONIL 80% WG: Rs. 1100/100gm.
Fertilizer (Urea): Rs. 295/50kg.
Rs. 50000/- was calculated as cost of production common agronomic practices.

Plant mortality due to white grub in different interaction or combination of insecticides and fertilizer

The result presented in (Table-4) showed that plant mortality due to white grub in different interaction or combination was significantly low as untreated combination plots at 30, 45, 60, 75 and 90 days after germination (DAG).

30 days after germination

At 30 DAG, the revealed that 12 different interactions were found significantly different. The order of treatment interaction on the bases of white grub damage on groundnut plant mortality was: $S_1P_1F_2$(1.50%) < $S_1P_1F_1$(3.91%) < $S_1P_0F_2$(9.78%) < $S_1P_0F_1$(10.61%) < $S_1P_1F_0$(11.11%) < $S_1P_0F_0$(12.52%) < $S_0P_1F_2$(13.58%) < $S_0P_1F_1$(13.59%) < $S_0P_1F_0$(14.98%) < $S_0P_0F_2$(19.74%) < $S_0P_0F_1$(20.33%) < $S_0P_0F_0$(30.25%). Among the treatment combinations, $S_1P_1F_2$ (1.50%) was found significantly superior to the other treatment combination. The highest plant mortality found in untreated combination $S_0P_0F_0$ (27.58%).

45 days after germination

After 45 DAG, The order of treatment interaction on the bases of white grub damage on groundnut plant mortality given in bracket was: $S_1P_1F_2$(1.67%) < $S_1P_1F_1$ (4.01%) < $S_1P_0F_2$(10.88%) < $S_1P_1F_0$(11.54%) < $S_1P_0F_1$(12.06%) < $S_1P_0F_0$(12.77%) < $S_0P_1F_2$(14.67%) < $S_0P_1F_1$(14.82%) < $S_0P_1F_0$(14.99%) < $S_0P_0F_2$(19.80%) < $S_0P_0F_1$(20.38%) < $S_0P_0F_0$(34.00%). Among the treatment combinations, $S_1P_1F_2$ (1.67%) was found significantly superior to the other treatment combination. The next best treatment was $S_1P_1F_1$ (4.01%). The highest plant mortality found in untreated combination $S_0P_0F_0$ (31.26%).

60 days after germination

After 60 DAG, The order of treatment interaction on the bases of white grub damage on groundnut plant mortality given in bracket was: $S_1P_1F_2$(1.78%) < $S_1P_1F_1$ (4.33%) < $S_1P_0F_2$(11.40%) < $S_1P_1F_0$(11.73%) < $S_1P_0F_1$(12.18%) < $S_1P_0F_0$(12.78%) < $S_0P_1F_2$(14.48%) < $S_0P_1F_1$(14.90%) < $S_0P_1F_0$(16.47%) < $S_0P_0F_2$(20.22%) < $S_0P_0F_1$(21.32%) < $S_0P_0F_0$(34.60%). Among the treatment combinations, $S_1P_1F_2$ (1.78%) was found significantly superior to the other treatment combination. The next best treatment was $S_1P_1F_1$ (4.33%). The highest plant mortality found in untreated combination $S_0P_0F_0$ (31.80%).

Table 4: Efficacy of insecticides and fertilizer (combination) against white grub infesting groundnut

Sr. No.	Treatment	Plant Mortality (%)					Average Number of Grub/m^2
		30 DAG*	45 DAG	60 DAG	75 DAG	90 DAG	
1	S_0 P_0 F_0	30.25** (27.58)	34.00 (31.26)	34.60 (31.80)	35.00 (32.89)	35.10 (33.06)	4.97*** (24.67)
2	S_0 P_0 F_1	26.80 (20.33)	26.82 (20.38)	27.50 (21.32)	27.98 (22.01)	29.23 (23.85)	4.35 (18.92)
3	S_0 P_0 F_2	26.38 (19.74)	26.41 (19.80)	26.72 (20.22)	26.80 (20.60)	27.42 (21.20)	4.04 (16.29)
4	S_0 P_1 F_0	22.77 (14.98)	22.80 (14.99)	23.94 (16.47)	23.98 (16.55)	24.41 (17.11)	3.77 (14.19)
5	S_0 P_1 F_1	21.63 (13.59)	22.64 (14.82)	22.71 (14.90)	23.05 (16.41)	24.34 (16.99)	3.64 (13.27)
6	S_0 P_1 F_2	21.54 (13.48)	22.52 (14.67)	22.60 (14.86)	22.29 (14.38)	22.48 (14.62)	3.54 (12.53)
7	S_1 P_0 F_0	20.72 (12.52)	20.93 (12.77)	20.95 (12.78)	21.63 (13.58)	21.93 (13.95)	3.31 (10.98)
8	S_1 P_0 F_1	19.01 (10.61)	20.32 (12.06)	20.43 (12.18)	20.56 (12.40)	20.80 (12.61)	2.89 (8.33)
9	S_1 P_0 F_2	18.22 (9.78)	19.26 (10.88)	19.74 (11.40)	19.61 11.26	20.35 (12.09)	2.45 (5.99)
10	S_1 P_1 F_0	19.47 (11.11)	19.86 (11.54)	20.03 (11.73)	20.42 (11.80)	20.94 (12.77)	2.70 (7.31)
11	S_1 P_1 F_1	11.41 (3.91)	11.55 (4.01)	12.01 (4.33)	12.56 (4.73)	12.75 (4.80)	1.52 (2.30)
12	S_1 P_1 F_2	7.05 (1.50)	7.44 (1.67)	7.67 (1.78)	8.05 (1.96)	9.09 (2.49)	1.21 (1.46)
	S.E m.±	0.84	1.23	1.14	1.05	1.26	0.16
	CD at 5%	2.48	3.60	3.36	3.07	3.68	0.46
	CV%	7.25	10.28	9.45	8.51	10.00	8.41

Note:
S_0: no seed treatment, S_1: imidacloprid 40% + fipronil 40% (80% WG) @ 2 g/kg, P_0: no pesticide treatment, P_1: Chlorpyriphos 20% EC @ 4 lit/ha, F_0: no fertilizer treatment, F_1: Application of urea 25 kg/ha (11.5 kg N_2 / ha), F_2: Application of urea 50 kg/ha (23 kg N_2 / ha).
* DAG = Days after germination.
**Arcsine percentage transformed value.
*** $\sqrt{X + 0.5}$ transformed values.
Figures in Parentheses are retransformed value.

75 days after germination

After 75 DAG, The order of treatment interaction on the bases of white grub damage on groundnut plant mortality given in bracket was: $S_1P_1F_2$(1.96%) < $S_1P_1F_1$ (4.73%) < $S_1P_0F_2$(11.26%) < $S_1P_1F_0$(11.80%) < $S_1P_0F_1$(12.40%) < $S_1P_0F_0$(13.58%) < $S_0P_1F_2$(14.38%) < $S_0P_1F_1$(16.41%) < $S_0P_1F_0$(16.55%) < $S_0P_0F_2$(20.60%) < $S_0P_0F_1$(22.01%) < $S_0P_0F_0$(35.00%). Among the treatment combinations, $S_1P_1F_2$ (1.96%) was found significantly superior to the other treatment combination. The next best treatment was $S_1P_1F_1$ (4.73%). The highest plant mortality found in untreated combination $S_0P_0F_0$ (32.89%).

90 days after germination

After 90 DAG, The order of treatment interaction on the bases of white grub damage on groundnut plant mortality given in bracket was: $S_1P_1F_2$(2.49%) < $S_1P_1F_1$(4.80%) < $S_1P_0F_2$(12.09%) < $S_1P_1F_0$(12.77%) < $S_1P_0F_1$(12.61%) < $S_1P_0F_0$(13.95%) < $S_0P_1F_2$(14.62%) < $S_0P_1F_1$(16.99%) < $S_0P_1F_0$(17.11%) < $S_0P_0F_2$(21.20%) < $S_0P_0F_1$(23.85%) < $S_0P_0F_0$(35.06%). Among the treatment combinations, $S_1P_1F_2$(1.96%) was found significantly superior and it was at par with $S_1P_1F_1$ (4.80%). The highest plant mortality found in untreated combination $S_0P_0F_0$ (33.06%).

Grub population

The (Table-4) indicated that the order of treatment interaction on the bases of white grub damage on groundnut plant mortality given in bracket was: $S_1P_1F_2$(1.46) < $S_1P_1F_1$(2.30) < $S_1P_0F_2$(5.99) < $S_1P_1F_0$(7.31) < $S_1P_0F_1$(8.33) < $S_1P_0F_0$(10.98) < $S_0P_1F_2$(12.53) < $S_0P_1F_1$(13.27) < $S_0P_1F_0$(14.19) < $S_0P_0F_2$(16.29) < $S_0P_0F_1$(18.92) < $S_0P_0F_0$(24.67). The lowest grub population can be found in $S_1P_1F_2$ and highest grub population can be found in the without treatment combination of $S_0P_0F_0$.

The overall most effectiveness treatment combination and lowest plant mortality found on $S_1P_1F_2$ and $S_1P_1F_1$. When use of high fertilizer doses with seed treatment and pesticide treatment minimize the grub population.

Pod Yield

The data on pod yield harvested from the different treatments are summarized in (Table-5) and revealed that all seed treatment, insecticidal and high dose of fertilizer treatment combination recorded significantly higher pod yield than untreated treatments (control). The chronological order of yield kg /ha in comparison to untreated treatments (control) given in bracket was: $S_1P_1F_2$ (2566) > $S_1P_1F_1$ (2553) > $S_1P_0F_2$ (2508) > $S_1P_1F_0$ (2334) > $S_1P_0F_1$ (2267) > $S_1P_0F_0$ (2226) > $S_0P_1F_2$ (2051) > $S_0P_1F_1$ (1989) > $S_0P_1F_0$ (1919) > $S_0P_0F_2$ (1886) > $S_0P_0F_1$ (1715) > $S_0P_0F_0$ (935). The highest (2566 kg /ha) pod yield harvested in the plots treated with $S_1P_1F_2$ but it was at par with $S_1P_1F_1$, $S_1P_0F_2$, $S_1P_1F_0$ and$S_1P_0F_1$. The next treatment was $S_1P_0F_0$ and it was at par with the $S_0P_1F_2$, $S_0P_1F_1$ and $S_0P_1F_0$. Where $S_0P_0F_2$ and $S_0P_0F_1$ found comparatively lowest yield. The lower yield can found in the untreated combination plot $S_0P_0F_0$.

Dry fodder yield

The data on fodder yield harvested from the different treatments are summarized in (Table-5) and revealed that all seed treatment, insecticidal and high dose of fertilizer treatment combination recorded significantly higher fodder yield than untreated treatments (control). The chronological order of yield kg /ha in comparison to untreated treatments (control) given in bracket was: $S_1P_1F_2$ (6110) >$S_1P_1F_1$ (6005) > $S_1P_0F_2$ (5901) > $S_1P_1F_0$ (5678) > $S_1P_0F_1$ (5573)> $S_1P_0F_0$ (5469) > $S_0P_1F_2$ (5365) > $S_0P_1F_1$ (5226) > $S_0P_1F_0$ (5087) > $S_0P_0F_2$ (5103) > $S_0P_0F_1$ (4825) > $S_0P_0F_0$ (3228). The highest (6110 kg /ha) fodder yield harvested in the plots treated with $S_1P_1F_2$ and it was statistically at par with $S_1P_1F_1$, $S_1P_0F_2$, $S_1P_1F_0$ and $S_1P_0F_1$. The treatment was $S_1P_0F_0$ found moderately yield (5469 kg/ha) and it was at par with $S_0P_1F_2$, $S_0P_1F_1$, $S_0P_1F_0$ and $S_0P_0F_2$. $S_0P_0F_1$ found comparatively lowest yield. The lowest yield can be found in the untreated combination plot $S_0P_0F_0$.

Net incremental cost benefit ratio

Further, it could be seen from the results that the highest NICBR was recorded in the $S_1P_1F_2$ (1:77), $S_1P_1F_1$ (1:1.75) and $S_1P_1F_0$ (1:1.71). The lowest NICBR (1:0.26) was obtained in the $S_0P_0F_0$. It could be proved from the results that the treatment combination of $S_1P_1F_2$ and $S_1P_1F_1$ was highest NICBR.

Similar works have not been found more. But some scientists have been reported on groundnut and another crop cocoa, reported Anonymous (2014) [1] and Veeresh (1974) [4]. Which support this research for post application of nitrogen (urea).

Table 5: Economics of different insecticides and fertilizer (Combination) evaluated against white grub

Treatments	Cost of Cultivation (Rs/ha)			Average Yield (kg/ha)		Gross income (Rs/ha)			Net profit (Rs/ha)	ICBR
	Insecticides and fertilizer (Rs/ha)	Common cultivation practices	Total (Rs/ha)	Pod	Dry fodder	Pod	Dry fodder	Total		
$S_0P_0F_0$	0	50000	50000	935	3228	37381	25822	63203	13203	1:0.26
$S_0P_0F_1$	148	50000	50148	1715	4825	68608	38599	107207	57060	1:1.14
$S_0P_0F_2$	295	50000	50295	1886	5103	75442	40822	116264	65969	1:1.31
$S_0P_1F_0$	1700	50000	51700	1919	5087	76766	40699	117465	65765	1:1.27
$S_0P_1F_1$	1848	50000	51848	1989	5226	79569	41810	121379	69532	1:1.34
$S_0P_1F_2$	1995	50000	51995	2051	5365	82041	42921	124962	72967	1:1.40
$S_1P_0F_0$	2750	50000	52750	2226	5469	89029	43755	132784	80034	1:1.52
$S_1P_0F_1$	2898	50000	52898	2267	5573	90695	44588	135283	82385	1:1.56
$S_1P_0F_2$	3045	50000	53045	2334	5678	93374	45421	138795	85750	1:1.62
$S_1P_1F_0$	4450	50000	54450	2508	5901	100306	47211	147517	93067	1:1.71
$S_1P_1F_1$	4598	50000	54598	2553	6005	102111	48044	150155	95557	1:1.75
$S_1P_1F_2$	4745	50000	54745	2566	6110	102625	48877	151503	96758	1:1.77

Note:

S_0: no seed treatment, S_1: imidacloprid 40% + fipronil 40% (80% WG) @ 2 g/kg, P_0: no pesticide treatment, P_1: Chlorpyriphos 20% EC @ 4 lit/ha, F_0: no fertilizer treatment, F_1: Application of urea 25 kg/ha (11.5 kg N_2 / ha), F_2: Application of urea 50 kg/ha (23 kg N_2 / ha).

Labour Charge: Rs. 200/Day, Price of groundnut pod: Rs. 40/kg., Price of groundnut fodder: 8/kg.

CHLORPYRIPHOS 20% EC: Rs. 300/1litre, IMIDACLOPRID + FIPRONIL 80% WG: Rs. 1100/100gm.

Fertilizer (Urea, company-GNFC): Rs. 295/50kg. Rs. 50000/- was calculated as cost of production common agronomic practises.

Conclusion

The lowest plant mortality was recorded in 30 to 90 day in (S_1: imidacloprid 40% + fipronil 40% - 80 WG @ 50 g per ha) and the high fertilizer dose (F_2: urea 50 kg/ha). When combination of S_1 P_1 F_2 S_1: imidacloprid 40% + fipronil 40% (80% WG) @ 2 g/kg, P_1: Chlorpyriphos 20% EC @ 4 lit/ha and F_2: Application of urea 50 kg/ha (23 kg N_2 / ha lowest plant mortality found. So it`s result indicated that higher doses of fertilizer with combination of seed treatment and pesticide suppressed the grub population and yield is increases than the single insecticide treatment.

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