Int.J.Curr.Microbiol.App.Sci (2017) *6*(7): 957-966

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 7 (2017) pp. 957-966**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.607.117

Bio Efficacy of Chlorphyriphos 20 EC as Seed Treatment and Yield Loss Estimation and Economics against *Holotrichia fissa* Brenske in Groundnut under Rainfed Condition

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Keywords

Bio efficacy, Chlorphyriphos, *Holotrichia fissa*, Yield loss estimation, Groundnut.

Article Info

Accepted:
14 June 2017
Available Online:
10 July 2017

A B S T R A C T

Study on management of groundnut root grub *Holotrichia fissa* Brenske was carried out at Hattarwata village of Chikkodi (Belagavi district) during 2014-15 in *kharif* season. The yield loss also increased with the increase in grub density both in untreated and seed treated conditions under field conditions. However, under untreated conditions minimum per cent yield loss was recorded in T_1 (9.63) with net returns of Rs. 53,315/-under field conditions. The per cent yield loss over control under treated conditions in T_1 was 2.14 with net returns of Rs. 59,982/-. Whereas T_6 recorded 35.78 per cent yield loss over control with net returns of Rs. 23,315/-, respectively.

Introduction

White grubs (Coleoptera: Scarabaeidae) are soil inhabiting and root feeding immature stages of scarab beetles. The white grub family, Scarabaeidae is the second largest family within the order Coleoptera. The world fauna of white grub exceeds 30,000 species (Mittal, 2000) and there are about 1300 North American species (Borror *et al.,* 1975). The maximum number occurs in the tropical areas of the world, particularly in African and Oriental regions. White grubs are polyphagous and one of the five pests of national importance in India and is serious pest and became one of the major constraint in production of many annual crops *viz.,* groundnut, pearl millet, sorghum, cowpea, pigeonpea, greengram, clusterbean, chilli and perennial crops like sugarcane, tea, coffee and arecanut. In endemic areas the damage to crops ranges from 20 to 100 per cent. The life cycle usually requires one to three years to complete. White grub larvae cause severe damage to groundnut as well as other commercial crops like potato, sugarcane, pea, maize etc., whereas for plants like bajra, sorghum and maize have adventitious root system can withstand much. The affected plants show varying degrees of yellowing, wilting and death (Rai *et al.,* 1969). The affected plants can be pulled up easily.

Patches of dead plants are seen throughout the field which later coalesces to produce intensive areas of damage (Veeresh, 1977). Several species have been observed to cause serious damage throughout the country right from Himalaya to Kerala and Gujarat to North eastern regions (Chandla *et al.*, 1988). The species of *Holotrichia* are well distributed in the Indian subcontinent and found to be very destructive. Nearly 300 species of white grubs were recorded from India (Mishra, 1995).

The fauna of the Indian sub-region is very rich and diverse but it is yet to be fully explored (Mishra and Singh, 1999). There are two major white grub pest species on groundnut in India *viz.*, *Holotrichia consanguinea* Blanchard and *H. serrata*. Of these *H. consanguinea* is the key white grub pest in the northern parts of the country and finds loose sandy, well drained soil to be quite suitable for its survival and multiplication. It is the dominant white grub species in the states of Rajasthtan, Gujarat, Haryana, Punjab, Utter Pradesh and Bihar, *H. serrata* is dominant in Karnataka, Maharashtra, Andhra Pradesh and Tamil Nadu and survives in well drained heavy, red alluvial and black cotton soils (Yadava, 1991). Another white grub *H. fissa* is recorded from Kerala, Karnataka, Haryana (Verma, 1975; Veeresh, 1975; Abraham and Rajendran, 1978). In many districts of Maharashtra *H. fissa* turned out to be a serious problem in rain fed areas *viz.*, Ahemadnagar, Dhule, Nanded, Buldhana, Osmanabad, Sangli and Satara (Bhawane *et al.*, 2011).

In recent times *Holotrichia fissa* Brenske is emerging as a major pest on groundnut and other crops under rain-fed situations of Belagavi district. *H. fissa* was economically important and found in large numbers as compared to other species in Hattarwat village of Chikkodi taluk on ber. Groundnut, soybean, maize and paddy were infested by *H. fissa* and *H. serrata* (Tippannavar and Patil, 2013). Therefore, there is a need to evolve suitable management strategy to tackle this pest under rain fed conditions. Hence, the present study was under taken to know bio efficacy of chlorphyriphos 20 EC as seed treatment for effective management of this pest.

Materials and Methods

Mass rearing of *H. fissa*

The adult beetles of *H. fissa* were collected immediately after first rains from endemic areas of Chikkodi and Hukkeri taluks and used to get grubs of known instar and age to study the seed treatment effect under field condition.

The field collected beetles were brought to laboratory at UAS Dharwad and confined to big plastic crates (0.24 m^2).Three fourth was filled with soil and organic matter in 1:1 proportion. Soil was kept moist by sprinkling water daily. Leafy branches of ber were provided in the crates as food for beetles. The eggs collected from moist soil later were transferred to the earthen crates containing soil and organic matter mixture. Later to these crates ragi (finger millet) seeds were sown to provide root material as food for the second and third instar grubs and were used for experimentation.

Management of *H. fissa* through seed treatment

Study area and period

A field experiment was conducted at Hattarawata village of Chikkodi taluk, Belagavi district during 2014-2015 cropping season to find out the effect of seed treatment in reducing the loss against *H. fissa*. The groundnut local variety Western-6 was sown

during July 27, 2014 with micro plot size of 1x1 m^2 and gross plot of 28.2 m^2 following all the recommended package of practices except root grub management. The lateral movement of grubs from one micro plot to another was prevented by putting 2 mm wire mesh barrier. For seed dressing a known quantity of seeds was placed in a polyethylene bag; then Chlorpyriphos 20 EC@ 25 ml/kg seed along with very little quantity of water was added to it and the bag was swirled gently to provide uniform coat.

Treated seeds were shade dried and then sown in furrows. Two sets of experiments done with same treatment details but one set was seed treatment of groundnut with Chlorpyriphos 20 EC@ 25 ml/kg [Treated plot,(T)] and another set was without seed treatment [Untreated plot, (UT)].

Experimental design, observations recorded and statistical analysis

Experimental design

Experiment was laid as Randomized block design (RBD) with seven treatments and three replications for both sets [treated (T) and untreated (UT)].

Different number of grubs which were maintained in the laboratory was released per plot (1×1 m^2). The 3rd instar grubs were released after 15 days of sowing of groundnut.

Observations recorded

Plant mortality was recorded by counting the wilted plants. Observations were made separately on per cent mortality of plants at 30, 40 and 60 days after sowing. In each treatment number of plants died due to grub attack was recorded. At harvest, pod yield per plot was recorded.

Statistical analysis

The data obtained on different parameters were subjected to Duncan's Multiple Range Test (DMRT).

Result and Discussion

Effect of chlorphyriphos 20 EC @ 25ml/kg seed treatment against *Holotrichia fissa* Brenske on groundnut under field condition

30 DAS

At 30 days after sowing the plant mortality under unprotected condition ranged from 0.00 to 70.37 per cent. Whereas under protected condition no plant mortality was recorded. Under untreated condition highest mortality (70.37) was affected in T_6 (six grubs per m^2) followed by five grubs (51.85) which is on par with T_4 with 48.15 per cent. T_2 (two grubs/m^2) and T_3 (3 grubs/m^2) were statistically on par with each other with mortality of 22.22 and 33.33 per cent, respectively. Lower mortality of 18.52 per cent was observed in T_1 with (one grub/ m2). No treatments were found to be superior over untreated check under unprotected conditions while in case of protected conditions all the treatments were on par with UTC (Table 1).

40 DAS

At 40 days after sowing the cumulative plant mortality under untreated condition ranged from 29.63 to 86.22 per cent. The highest mortality under unprotected condition was recorded in T_6 with 86.22 per cent followed by T_5 (70.37) >T_4 (55.56) >T_3 (41.42) respectively (Table 2). T_2 and T_1 were on par with each other. While under protected condition cumulative plant mortality ranged from 1.50 to 9.20 with highest mortality in T_6 which was on par with T_5 (8.11). Least

mortality was recorded in T_1 (1.50), while, T_2 and T_3 were statistically on par with each other. Untreated check recorded no mortality. Highest cumulative plant mortality under both unprotected and protected condition was recorded in T_6 which was on par with T_5 (8.11). Least mortality was recorded in T_1 (1.50), while, T_2 and T_3 were statistically on par with each other. Untreated check recorded no mortality. Highest cumulative plant mortality under both unprotected and protected condition was recorded in T_6 with 86.22 and 9.20 per cent respectively. No plant mortality was recorded in UTC in both the conditions (Table 2).

60 DAS

At 60 days after sowing the cumulative plant mortality ranged from 31.33 to 93.67 under unprotected conditions while in case of protected conditions it varied between 2.33 to 13.12 per cent. No treatments were significantly superior over control both under protected and unprotected conditions. Highest plant mortality of 93.67 and 13.12 was recorded in T_6 under both untreated and seed treated conditions. Least was affected in T_1 with 31.33 and 2.33 per cent. T_2 and T_3 were statistically on par with each other under unprotected condition while under protected condition T_3 was on par withT_2 and T_4 (Table 2).

Irrespective of the conditions untreated plots recorded higher per cent plant mortality from 26.49 to 83.42 per cent under field condition. Whereas seed treated plots recorded plant mortality 1.28 to 7.22 per cent at different grub loads, respectively (Fig. 1). The chemical control of white grub *H. serrata* through seed treatment using different chemicals, seed dressing of chlorpyriphos 20EC @ 6ml/kg has recorded 4 per cent plant mortality and 92 per cent larval mortality (Anitha, 1996). This is in variance with present study with respect to plant mortality under seed treated plots against *H. fissa.*

Anitha (1996) who recorded the residues of chlorpyriphos in seedlings at '0', 5, 10, 20 days time. At '0' day residue level was 1.4077 ppm, which decreased to 1.3986 ppm, 1.3839 ppm and 1.3705 ppm in 5, 10 and 20 days, respectively. However, at the time of harvest the residual effect was Below Detectable Level in kernels and haulms. This very well proves the report after 30 DAS even in seed treated plots the plant mortality was recorded leading to yield reduction. Chlorpyriphos seed treatment in groundnut had no adverse effect on the germination of seed against *Anomala dimidiate*. Seed treatment with chlorpyriphos 20 EC @ 25ml/kg and was most effective in controlling the white grub population (Mishra and Singh, 1994).

Table.1 Treatment details

Treatments	Grub load/plot (1×1m^2)	Dosage
T-1	One	Chlorpyriphos 20 EC@ (25 ml./kg seed)
T-2	Two	Chlorpyriphos 20 EC@ (25 ml./kg seed)
T-3	Three	Chlorpyriphos 20 EC@ (25 ml./kg seed)
T-4	Four	Chlorpyriphos 20 EC@ (25 ml./kg seed)
T-5	Five	Chlorpyriphos 20 EC@ (25 ml./kg seed)
T-6	Six	Chlorpyriphos 20 EC@ (25 ml./kg seed)
T-7	Control (no release)	Chlorpyriphos 20 EC@ (25 ml./kg seed)

Table.2 Effect of seed treatment against *Holotrichia fissa* Brenske in groundnut under field condition at Hattarawata during Kharif -2014

Treatments	Number of grubs/plot	Cumulative plant mortality							
		30DAS		40DAS		60DAS		Mean	
		UT	T	UT	T	UT	T	UT	T
T-1	One	18.52 (25.44) **d**	0.00 (0.71)	29.63 (32.91)**e**	1.50 (6.97)**d**	31.33 (33.27)**e**	2.33 (8.77)**d**	26.49	1.28
T-2	Two	22.22 (28.12) **d**	0.00 (0.71)	31.11 (33.89)**e**	3.70 (11.09)**c**	38.33 (38.26)**d**	5.72 (13.83)**c**	30.55	3.14
T-3	Three	33.33 (35.26) **c**	0.00 (0.71)	43.77 (41.42) **d**	4.33 (12.01)**c**	46.48 (42.97)**d**	7.71 (16.11)**bc**	40.18	4.01
T-4	Four	48.15 (43.93) **b**	0.00 (0.71)	55.56 (48.23) **c**	7.40 (15.78)**b**	63.70 (53.00)**c**	10.11 (18.25)a**b**	55.80	5.84
T-5	Five	51.85 (46.06) **b**	0.00 (0.71)	70.37 (57.11) **b**	8.11 (16.54)**ab**	81.48 (65.15)**b**	11.70 (20.00)**a**	67.90	6.63
T-6	Six	70.37 (57.11) **a**	0.00 (0.71)	86.22 (68.37) **a**	9.20 (17.63)**a**	93.67 (76.02)**a**	13.12 (21.23)**a**	83.42	7.22
T-7	Control (no release	0.00 (0.71)**e**	0.00 (0.71)	0.00 (0.71)**f**	0.00 (0.71)**e**	0.00 (0.71)**f**	0.00 (0.71)**e**	-	-
SE.m±		**1.99**	**NS**	**2.07**	**0.41**	**2.47**	**0.98**		
C.D(5%)		**6.13**	**NS**	**6.37**	**1.27**	**7.61**	**3.02**		

Note: * figures in the parentheses are $\sqrt{x + 0.5}$and arcsine transformed values, mean followed by the same alphabet do not differ significantly (P=0.01) by DMRT.

UT- Untreated (without seed treatment)

T- Seeds treated with chlorphyriphos 20 EC @ 25ml/kg

Table.3 Effect of different densities of *Holotrichia fissa* Brenske on yield of groundnut (local variety: western-6) under field condition of Hattarawata Kharif -2014

Treatments	Number of grubs /m^2	Untreated Yield (q/ha)	Percent yield loss over control	Gross returns (Rs)	Net returs(Rs)	Treated Yield (q/ha)	Percent yield loss over control	Gross returns (Rs)	Net returns (Rs)
T-1	One	19	9.63	97000	53,315	21	2.14	1,06,667	59,982
T-2	Two	18	17.70	88,333	44,648	20	9.02	99,167	52,482
T-3	Three	16	27.17	78,167	34,482	18	16.06	91,500	44,815
T-4	Four	13	40.06	64,333	20,648	17	20.64	86,500	39,815
T-5	Five	10	55.14	48,150	4,465	16	26.61	80,000	33,315
T-6	Six	8	61.18	41,667	-2,018	14	35.78	70,000	23,315
T-7	Control (no release)	21	-	1,07,333	63,648	22	-	1,09,000	62,315

UTC- Untreated check
*Market price of the groundnut during the season ₹ 5000/q
*Cost of cultivation under unprotected condition: ₹43,685 /ha
*Cost of cultivation under protected condition: ₹ 46,685/ha

Fig.1 Effect of seed treatment against *Holotrichia fissa* Brenske in groundnut under field condition at Hattarawata during Kharif -2014

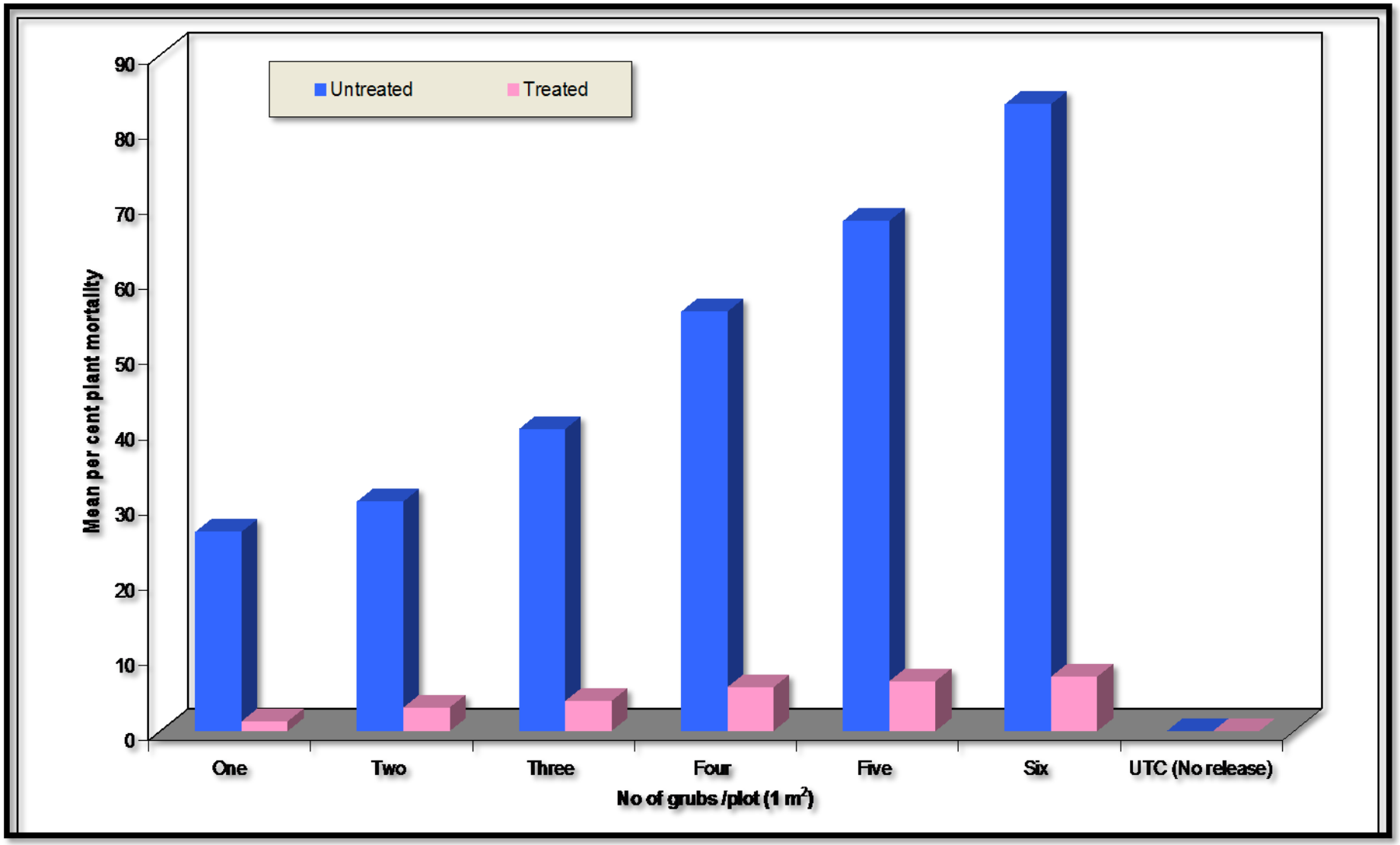
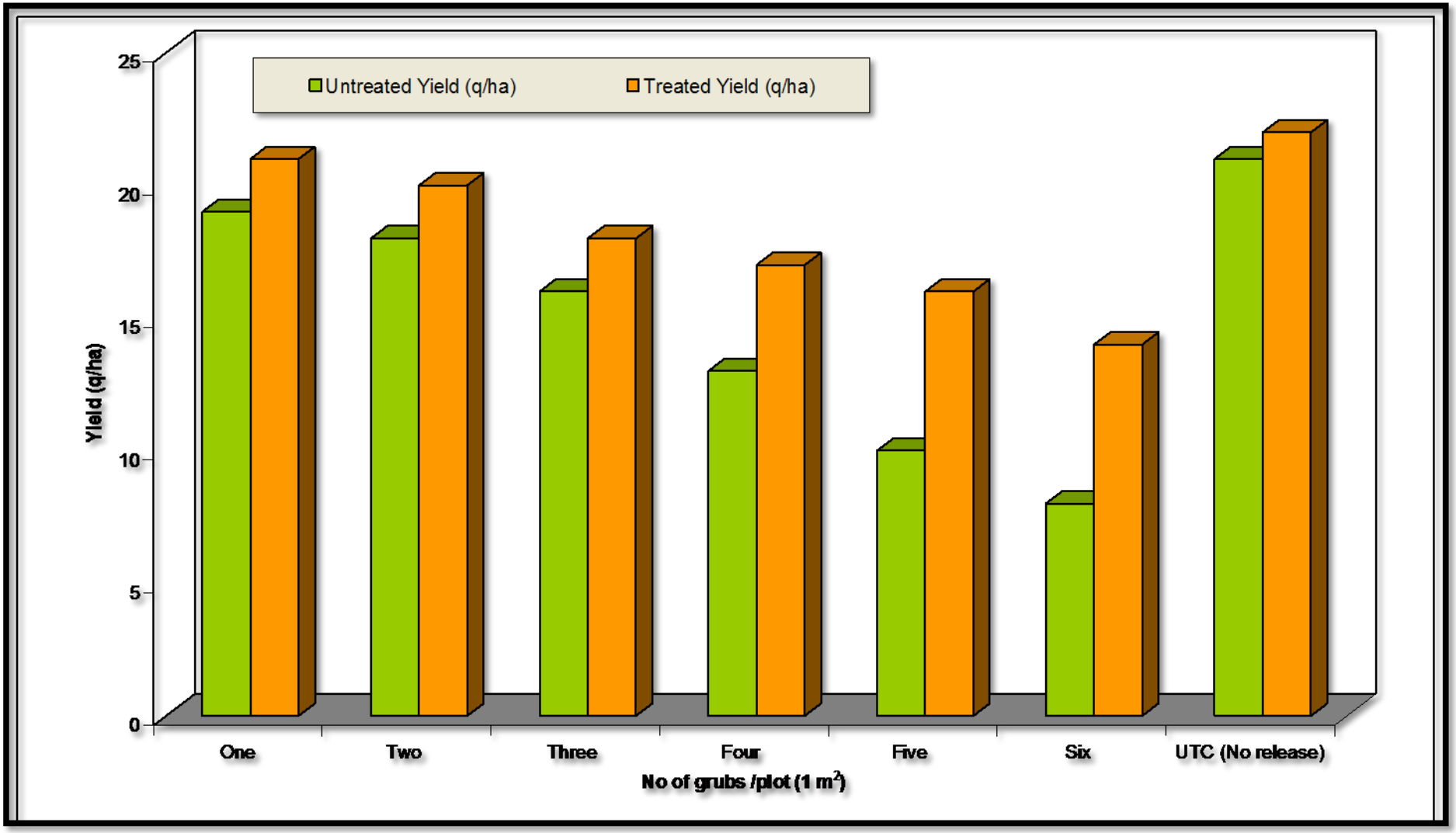


Fig.2 Effect of different densities of *Holotrichia fissa* Brenske on yield of groundnut (local variety: western-6) under field condition of Hattarawata Kharif -2014



Seed treatment of chlorpyriphos 20 EC @ 5 g a.i./kg has recorded plant mortality of 4.43 per cent with 0.17 grubs/0.25m^2 and 71.38 per cent decrease in plant mortality over control and yield was 28.11q/ha while UTC recorded 15.48 per cent plant mortality, with 1.00 grubs/0.25m^2 and yield of 19.35 q/ha in maize from H.P. against *Holotrichia* sp. (Patial and Bhagat, 2005).

Yield loss estimation and economics due to *Holotrichia fissa* Brenske in groundnut under field conditions

The yield decreased with increase in grub density. The maximum yield of 19 q/ha was recorded in T_1 with yield loss of 9.53 per cent over control, worth of Rs. 53.315/-, While, under seed treated conditions yield was 21 q/ha was with lesser per cent yield loss of 2.14 over control and net returns obtained was Rs.59,982/-. The maximum yield loss of 61.18 per cent over control was affected by in T_6 (six grubs per m^2) with yield of 8q/ha resulting in negative returns of Rs. 2,018 /- under untreated conditions. Whereas, in case of seed treated conditions yield loss of over control was 35.78 per cent yielding net returns of Rs. 23,315/- (Table 3).

The yield loss also increased with the increase in grub density both in untreated and seed treated conditions. However, minimum yield loss was recorded in T_1 (one grub) and maximum was recorded in T_6 under both the conditions (Fig. 2). Seed treatment with chlorpyriphos @ 25 ml/kg seed recorded only 8.8 per cent plant damage and only 2.4 per cent pod damage with higher pod yield of 1696 kg/ha and CBR (1:11.00) with net return of Rs. 9350/ha. Effectiveness of chlorpyriphos @ 25 as seed dressing agents in groundnut against *H. consanguinea* was reported by Kapadia *et al.,* (2010). Seed treatment with chlorpyriphos @ 25 ml/kg seed recorded 30.60 per cent plant mortality, mean grub load of 1.7/plot (5×5m) and yield of 7.16 kg/plot and was the most economic with maximum net profit of Rs. 5132.20/ha also reported by Srivastava *et al.,* (1982)

In conclusion, the groundnut pod yield loss also increased with the increase in grub density both in untreated and seed treated conditions. However, minimum loss was recorded T_1 9.63 per cent yield loss over control under untreated conditions. Maximum yield loss was recorded in T_6 with 61.18 per cent yield loss over control under untreated conditions. Under seed treated plots T_1 recorded only 2.14 per cent yield loss over control. While T_6 recorded 35.78 per cent yield loss over control. Seed treatment of chlorpyriphos 20 EC @ 25 ml/kg found to be effective in managing this most devastating pest under rainfed conditions.

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How to cite this article:

Shrilakshmi, R.G. and Patil, R.R. 2017. Bio Efficacy of Chlorphyriphos 20 EC as Seed Treatment and Yield Loss Estimation and Economics against *Holotrichia fissa* Brenske in Groundnut under Rainfed Condition. *Int.J.Curr.Microbiol.App.Sci.* 6(7): 957-966.
doi: https://doi.org/10.20546/ijcmas.2017.607.117