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Paras Nath
B.P.S. Agricultural College, Purnia, Bihar, India

Anil Kumar
B.P.S. Agricultural College, Purnia, Bihar, India

PK Yadav
B.P.S. Agricultural College, Purnia, Bihar, India

Rajesh Kumar
Director, Student Welfare, B A U, Sabour, Bihar, India

Correspondence
Rajesh Kumar
Director, Student Welfare, B A U, Sabour, Bihar, India

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Estimation of losses caused by Aphid (*Rhopalosiphum nymphaeae* L.), Case worms (*Elophila depunctalis* W. & *E. crisonalis* W.) and Rib borer (*Chironomous* sp.) in Makhana Crop

Paras Nath, Anil Kumar, PK Yadav and Rajesh Kumar

Abstract
Makhana (*Euryale ferox* Salisb.), also known as Fox nut or Gorgon nut is an important minor aquatic fruit crop in India including Bihar and a good source of carbohydrate, protein and minerals. It is cultivated over an area of 20,000 ha in Bihar which constitutes about 80 per cent of the Makhana crop in the India but the production (3.18 lakh quintals) and productivity (21.25 q/ha) of Makhana crop is low due to many constraints, of which insect pests viz., aphid (*Rhopalosiphum nymphaeae*L.), case worms (*Elophila depunctalis* W.*& E. crisonalis* W) and rib borer (*Chironomous* sp.) under the changing cropping patterns and intensification of crop emerges as major constraints in getting maximum yield. Considering the economic losses caused by the insect pests, Field experiments were conducted under randomized block design (RBD) with four replications at Makhana research farm of Bihar Agricultural University, B.P.S. Agricultural College, Purnea during 2015and 2016 summer season. The Makhana Variety Swarna Vaidehi was transplanted in a plot size of 1000 square m by adopting standard production technology. Six treatments including untreated control were evaluated and protected plot having seed treatment with imidacloprid 70 WS @ 5 g/kg seed and root dip treatment with imidacloprid 70 WS @ 5 ml/Lt of water for half an hour at the time of transplanting along with three foliar spray of NSKE @ 0.5 per cent was found most effective in controlling the insect pests of Makhana as compare to unprotected plot. Seeds were harvested from 12 randomly selected spot from each of protected (best treatment plot) and unprotected plot by using quadrate of 01 sq. m for estimating the losses due to insect pest. The analysis of yield data of 2015 and 2016 summer season showed that the insect pests viz., aphid (*Rhopalosiphum nymphaeae* L.), case worms (*Elophila depunctalis* W.*& E. crisonalis* W.) and rib borer (*Chironomous* sp.) together causes yield loss to the tune of 17.04 to 23.66 per cent in Makhana crop.

Keywords: Makhana, Insect pest, Yield loss

Introduction
Makhana (*Euryale ferox* Salisb.), also known as Fox nut or Gorgon nut is an important minor aquatic fruit crop and a good source of carbohydrate, protein and minerals. It is cultivated over an area of 20,000 ha in Bihar which constitutes about 80% of the Makhana crop in the India with their production and productivity of 3.18 lakh quintals and 21.25 q/ha, respectively (Minten *et al.*, 2014) [2]. The production and productivity of Makhana crop is low due to several factors, out of which insect pests are of major limiting factors. The four dozen insect species were found associated with Makhana crop (Mishra *et.al*. 1992) [3], out of which the insect pests viz., aphid (*Rhopalosiphum nymphaeae* L.), case worms (*Elophila depunctalis* W. *& E. crisonalis* W.) and rib borer (*Chironomous* sp.) under the changing cropping patterns and intensification of crop emerges as major constraints in getting maximum yield (Paras Nath *et. al*. 2017) [4]. Both nymph and adult of aphid suck the sap from upper surface of leaves, which turn yellow/rust red, decay fast, affect the crop yields. The young larvae of case worms starts feeding by scraping the leaf surface either in middle or at the margin and makes an oval case by cut out the portion of the leaf and remains inside it, moving with the case on the leaves. The larva of this pest causes economic damage and significant reduction in yield of Makhana crop. The larvae of rib borer (*Chironomous* Spp.) were observed easily move inside the

aerenchymatous cavities of mid ribs of the leaves. The affected leaves turn yellow, decay fast and resulted in yield reduction. Realizing economic damage and yield reduction due to Inset Pest, the present investigation was carried out for estimating the yield loss caused by this pest in Makhana crop.

Materials and Methods

Field experiments were conducted under randomized block design (RBD) with four replications at Makhana research farm of Bihar Agricultural University, B.P.S. Agricultural College, Purnea during 2015 and 2016 summer season. The Makhana Variety Swarna Vaidehi was transplanted in a plot size of 1000 square m by adopting standard production technology. Six treatments including untreated control were evaluated and protected plot having seed treatment with imidacloprid 70 WS @5 gm/kg seed and root dip treatment with imidacloprid 70 WS @ 5 ml/Lt of water for half an hour at the time of transplanting along with three foliar spray of NSKE @ 0.5 % was found most effective in controlling the insect pests of Makhana as compare to unprotected plot. Seeds were harvested from 12 randomly selected spot from each of protected (Best treatment plot) and unprotected plot by using quadrate of 01 sq. m for estimating the losses due to insect pest. The statistical analysis of yield data was done by ''t'' test to estimate the yield loss caused by important insect pest in Makhana using formula.

$$\text{Avoidable loss (\%)} = \frac{Yield\ of\ protected\ plot - Yield\ of\ unprotected\ plot}{Yield\ of\ protected\ plot} \times 100$$

Results and Discussion

The data on seed yield per sq. m from 12 randomly selected spot was collected from protected and unprotected experimental plot are presented in Table 1&2 and Fig. 1. The statistical analysis of yield data collected (Table 1& Fig. 1) during crop season 2015 at the time of harvest showed that the seed yield obtained from protected and unprotected plot was in the range of 3378 to 3940 kg/ha and 2666 to 3471 kg/ha with average yield of 3675 and 3049 kg/ha, respectively. The increment in seed yield in protected plot over unprotected plot was in the range of 380 to 949 kg/ha with average yield of 626 kg/ha. The reduction in seed yield varied from 10.77 to 24.52 per cent losses, respectively with average reduction of 17.04 per cent.

The analysis of yield data (Table 2& Fig.1) of crop season 2016 showed that the average seed yield obtained from protected and unprotected plot was 3584.08 and 2734.08 kg/ha which varied in the range of 3254 to 3841kg/ha and 2435 to 3153 kg/ha, respectively. The average seed yield increment from protected plot over unprotected plot was 850 kg/ha which varied in the range of 472 to 1166 kg/ha. The average reduction in seed yield was 23.66 per cent and varied in the range of 13.02 to 30.36 per cent, respectively.

The present finding does not find support or contradicts earlier findings due to the paucity of information on insect pest in Makhana crop. However, the present finding derive the support from earlier findings for estimation of losses due to insect pest in Sesame by the same methods as reported by Wazire and Patel (2016) [6], Rohilla and Singh (1992) [5] and Ahuja and Bakhetia (1995) [1].

Table 1: Estimation of losses caused by Aphid, Caseworms & Rib borer in Makhana during 2015, summer season.

Quadrate No.	Yield (Kg/ha)		Difference in Yield (Kg/ha)	Deviation of mean difference (d)	d^2	Reduction in Yield (%)	Loss (Rs./ha)
	Protected	Unprotected					
1	3568	2846	722	96	9216	20.23	50540
2	3380	2724	656	30	900	19.40	45920
3	3892	3270	622	-4	16	15.98	43540
4	3378	2666	712	86	7396	21.08	49840
5	3940	3323	617	-9	81	15.66	43190
6	3583	3036	547	-79	6241	15.27	38290
7	3768	3256	512	-114	12996	13.59	35840
8	3528	3148	380	-246	60516	10.77	26600
9	3870	2921	949	323	104329	24.52	66430
10	3937	3471	466	-160	25600	11.84	32620
11	3388	2844	544	-82	6724	16.06	38080
12	3870	3083	787	161	25921	20.34	55090
Total	44102	36588	7514	-	259936	-	525980
Mean	3675	3049	626	-	-	17.04	43832

't' at 5 % Table 2.20 calculated 14.11

Table 2: Estimation of losses caused by Aphid, Caseworms & Rib borer in Makhana during 2016, summer season.

Quadrate No.	Yield (Kg/ha)		Difference in Yield (Kg/ha)	Deviation of mean difference (d)	d^2	Reduction in Yield (%)	Loss (Rs./ha)
	Protected	Unprotected					
1	3768	2965	803	-47	2209	21.31	56210
2	3475	2575	900	50	2500	25.90	63000
3	3645	2657	988	138	19044	27.11	69160
4	3785	2785	1000	150	22500	26.42	70000
5	3434	2735	699	-151	22801	20.36	48930
6	3675	2835	840	-10	100	22.86	58800
7	3254	2545	709	-141	19881	21.79	49630
8	3625	3153	472	-378	142884	13.02	33040
9	3465	2435	1030	180	32400	29.73	72100
10	3581	2634	947	97	9409	26.45	66290
11	3841	2675	1166	316	99856	30.36	81620
12	3461	2815	646	-204	41616	18.67	45220
Total	43009	32809	10200	-	415200	-	-
Mean	3584.08	2734.08	850	-	-	23.66	59500

't' at 5 % Table 2.20 calculated 15.16

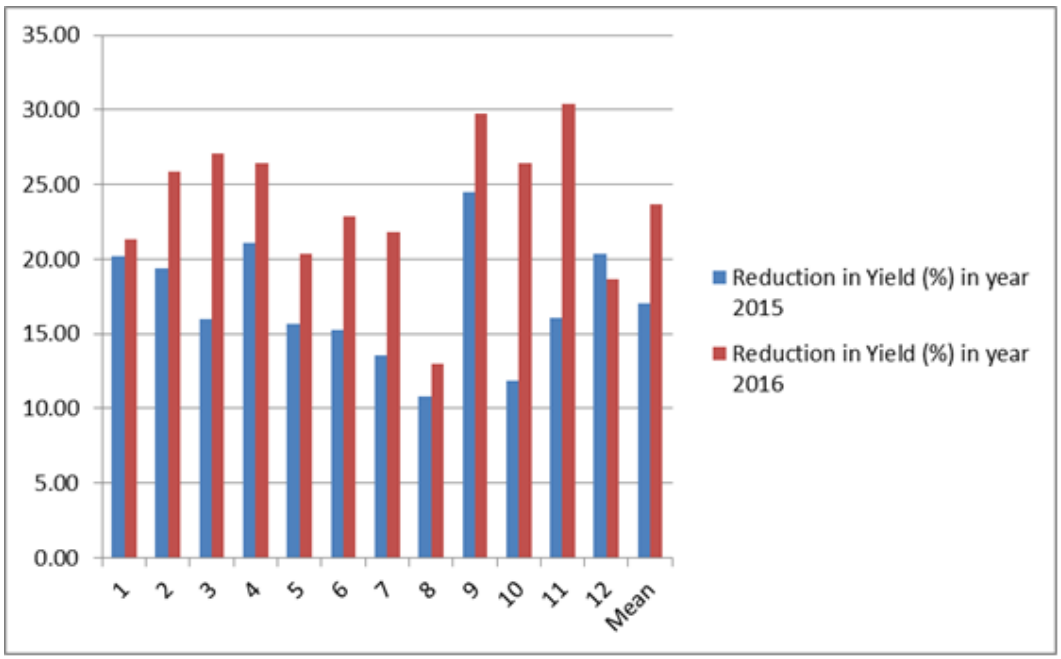

Fig 1: Per cent reduction in Yield over protected cultivation due to Insect Pest In Makhana

Conclusion

The results obtained herein depict that the estimated yield losses caused by insect pests viz., aphid (*Rhopalosiphum nymphaeae* L.), case worms (*Elophila depunctalis* W. *& E. crisonalis* W.) and rib borer (*Chironomous* sp.) in Makhana crop was to the tune of 17.04 to 23.66 per cent. Hence, eco-friendly management practices are needed for effective management of insect pest in Makhana crop to realize maximum yield potential.

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