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EFFECT OF HERBICIDE AND INSECTICIDE COMBINATION AGAINST WEEDS (*CONVOLVULUS ARVENSIS* AND *CELOSIA ARGENTEA*) AND SUCKING PESTS IN SOYBEAN

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ABSTRACT
A field experiment was conducted at Research Farm of IGKV, Raipur during *Kharif* 2013 and 2014 to evaluate the combined effect of herbicide and insecticide against the weed (*Convolvulus arvensis* and *Celosia argentea*),sucking pest (including jassid, aphid and white fly) and yield in soybean. All the herbicidal treatments recorded significantly at par in reducing weed count and weed dry matter. Imazathapyr 10 SL@1.0 l ha^{-1} recorded lowest weed count, weed dry matter and highest weed control efficiency (94.81% and 99.59% in 2013 and 2014 respectively). Rynaxypyre 20 EC @100 ml ha^{-1} recorded lowest pest count (1.18 insect $plant^{-1}$) in 2013 but in 2014, Indoxacarb 14.5 EC @ 300 ml ha^{-1} + Imazathapyr 10 SL @1.0 l ha^{-1} recorded lowest pest incidence (2.12 insect $plant^{-1}$). The highest seed yield (2323 kg ha^{-1}), net income (63655 ¹ /ha) and B:C ratio (3.09) was recorded under Imazathapyr 10 SL@1.0 l ha^{-1} in 2013. Whereas, in 2014, the highest seed yield (2459 kg ha^{-1}) was recorded by indoxacarb 14.5 EC @ 300 ml ha^{-1} + imazathapyr 10 SL @1.0 l ha^{-1} and highest net income (67767 ¹ ha^{-1}) was recorded under indoxacarb 14.5 EC @ 300 ml ha^{-1} + imazathapyr 10 SL @1.0 l ha^{-1} but B : C ratio (3.27) was superior under quinolphos 25 EC @1.5 l ha^{-1} + quizalophop ethyl 5 EC @ 1.0 l ha^{-1}.

INTRODUCTION

Soybean (*Glycine max*) is an important oil seed crop of India with high protein (40-42%) and oil (20-22%).In Chhattisgarh, soybean occupies 0.147 million ha with production of 0.134 million tone and average productivity of 915 kg ha^{-1} (www.sopa.org/REK2014.pdf, 2014).Soybean is very sensitive to early weed infestation. The critical crop weed competition period in soybean was observed at 27 to 40 days after sowing. The uncontrolled weeds at critical period of crop weed competition will reduce the yield of soybean by 58 to 85 per cent depending upon type and intensity of weed infestation (Jha *et al.*, 2014).Of the several factors responsible for poor yield, insect pests infestation is also considered as most important factor. In India, jassid (*Empoasca kerri*), aphid(*Aphis glycines*) and white fly (*Bemisia tabaci*) is considered as major sucking pest with about 20.47 per cent yield loss (Joshi and Patel, 2010).Hand weeding through hoeing is a common practice of weed controlin soybean(Jha *et al.*, 2014), however, due to non-availability of labour or continuous rains often prevents timely weed control. Under such situations, application of herbicides offers an alternate and equally effective method of weed control. Post-emergence herbicides provides the farmers to have a wide choice of application time from 10-30 days after sowing. Fewnewer post-emergence herbicides like imazethapyr, etc are found to control both broadleaved and grassy weed (Meena *et al.*, 2011) and mixed application of these herbicides with insecticide might be effective to weed as well as pest control in soybean crop.In the present study, an attempt was made to evaluate the bio-efficacy of broad spectrum insecticide along with herbicide against soybean weeds and pests.

MATERIALS AND METHODS

A field experiment was conducted to evaluate the efficacy of herbicide and insecticide against weeds and pest of soybean at Instructional cum Research Farm, Indira Gandhi KrishiVishwavidyalaya, Raipur (C.G.) during *kharif* 2013 and 2014. The experiment was laid out in Randomized Block Design (RBD) with four replication and twelve treatments which included rynaxypyre 20 EC @100 ml ha^{-1} ,indoxacarb 14.5 EC @ 300 ml ha^{-1} , quinolphos 25 EC @1.5 l ha^{-1} , imazathapyr 10 SL @1.0 l ha^{-1}, quizalophop ethyl 5 EC @ 1.0 l ha^{-1} as alone and with combination of herbicide and insecticide and Untreated Check. All the treatments were applied at 20 DAS (Day after sowing) as a tank mix at time of spraying. Soybean variety JS-335 was sown with spacing of 30 X 7 cm and seed rate of 65 kg ha^{-1} was used. The weed study in each plot was made at random from two selected spots and for this purpose quadrate (0.25 m^2) was used. Counting of weeds was done according to species and total population of weeds was also worked out and finally oven-dried at 60°C for 48 hours.The weed control efficiency was calculated on the basis of reduction in dry matter production of weeds in treated plots in comparison with weedy check and expressed in percentage

as suggested by (Mani *et al.,* 1973). Observation on sucking pest jassid (*Empoasca kerri*), aphid (*Aphis glycines*) and white fly (*Bemisia tabaci*) were taken by counting the number of pest (nymph/adult) from 3 leaves plant^{-1} (upper, lower and middle leaf) from 10 plants. Yield and yield attributes were recorded at harvest. The economics of soybean crop production pertaining to each of the treatment has been worked out in terms of cost of cultivation. Gross return (Rs. ha^{-1}) was obtained by converting the harvest into monetary terms at the prevailing market rate during the course of studies for every treatment. Net return (Rs. ha^{-1}) was obtained by deducting cost of cultivation from gross return.

The data on number of pests, weeds and weed dry matter were subjected to square root transformation $\sqrt{X + 0.5}$ before statistical analysis.

RESULTS AND DISCUSSION

Effects on pests

Incidence of sucking pest (jassid, aphid and white fly) were significantly reduced by different insecticidal treatments in 2013 but it was increases some extent in 2014 (Table 1). The incidence of pest population were recorded at 15 day after treatment and at flowering stage. The lowest number of pest population (1.18 insect plant^{-1}) was recorded under rynaxypyre 20 EC @100 ml ha^{-1} at 15 day after treatment and at flowering stage it was found non significant pest count during 2013. Whereas, during 2014, quizalophop ethyl 5 EC @ 1.0 l ha^{-1}recorded the lowest pest incidence (1.22 insect plant^{-1}) at 15 day after treatment, this was might be because of naturally unfavorable conditions for pest under this treatment. However at flowering stage, indoxacarb 14.5 EC @ 300 ml ha^{-1} + imazathapyr 10 SL @1.0 l ha^{-1}recorded lowest pest incidence (2.12insect plant^{-1}). The highest pest population was observed under the non insecticidal treatments. Similar trends were also recorded by Gupta (2008) and Joshi and Patel (2010).

Effects on weed

The different herbicidal treatment significantly reduces the weed count and weed dry matter of *Convolvulus arvensis* and *Celosia argentea*as compared to non herbicidal treatments and Untreated Check during both the year of experiment at 30 Day after treatment(Table 2). The lowest weed intensity(0.7 m^{-2}) and dry matter (0.7 g m^{-2}) of *Convolvulus arvensis* was recorded under the different herbicidal treatment of Imazathapyr 10 SL @ 1.0 l ha^{-1} and quizalophop ethyl 5 EC @ 1.0 l ha^{-1}, similar trend was also noticed by Khedkar *et al*. (2009) and Goud *et al*. (2013). However the highest weed intensity (2.12 m^{-2}) was recorded under quinolphos 25 EC @1.5 l ha^{-1} and Untreated Check and dry matter (2.26 g m^{-2}) under Untreated Check which was at par with indoxacarb 14.5 EC @ 300 ml ha^{-1} in first year of experiment whereas in the second year the highest weed intensity (1.51 m^{-2}) and dry matter (1.82 g m^{-2}) was recorded under Untreated Check showing at par result with indoxacarb 14.5 EC @ 300 ml ha^{-1} and quinolphos 25 EC @1.5 l ha^{-1}.

Imazathapyr 10 SL @ 1.0 l ha^{-1} and quizalophop ethyl 5 EC@ 1.0 l ha^{-1} treatments recorded the lowest weed count (0.7 m^{-2}) and weed dry matter (0.7 g m^{-2}) of *Celosia argentea* in both the year of experiment. Similar results were recorded by Kushwah and Vyas, (2005). Whereas the highest weed count and weed biomass were recorded under the non herbicidal treatment.Imazathapyr 10 SL @1.0 l ha^{-1}recorded highest weed control efficiency of 94.81% and 99.59% in 2013 and 2014, respectively. The results are conforming the observations by Khedkar *et al*. (2009)and Kushwah and Vyas, (2005).

Effects on yield

All herbicidal treatment significantly increased the yield and yield component like seed yield, number of pods plant^{-1} and seed index in soybean (Table 3). Number of pods plant^{-1} (61.65 and 72.25 pods plant^{-1} in 2013 and 2014, respectively) was recorded highest under rynaxypyre 20 EC @100 ml ha^{-1} + quizalophop ethyl 5 EC @ 1.0 l ha^{-1} during both the year of experiment. The seed index was found non significant in 2013 but in 2014 it was significantly higher (11.71 g) under rynaxypyre 20 EC @100 ml ha^{-1} + imazathapyr 10 SL @1.0 l ha^{-1}. Imazathapyr 10 SL @1.0 l ha^{-1} recorded highest seed yield (2323 kgha^{-1}) in 2013 but in 2014, indoxacarb 14.5 EC @ 300 ml ha^{-1} + imazathapyr 10 SL @1.0 l ha^{-1} recorded

Table 1: Effect of herbicide and insecticide on sucking pest in soybean

Treatments	Sucking pests (insect plant^{-1})			
	2013		2014	
	15 DAT	At Flowering	15 DAT	At Flowering
Rynaxypyre 20 EC @ 100 ml/ha	1.18(0.90)	0.95(0.40)	1.41(1.50)	2.91(8.00)
Indoxacarb 14.5 EC @ 300 ml/ha	1.76(2.60)	0.95(0.40)	1.50(1.75)	2.91(8.00)
Quinolphos 25 EC @ 1.5 l/ha	1.82(2.80)	0.89(0.30)	1.32(1.25)	2.54(6.00)
Imazathapyr 10 SL @ 1.0 l/ha	1.64(2.20)	1.00(0.50)	1.32(1.25)	3.27(10.25)
Quizalophop ethyl 5 EC @1.5 l/ha	1.82(2.80)	1.00(0.50)	1.22(1.00)	3.27(10.25)
Rynaxypyre 20 EC @ 100 ml/ha + Imazathapyr 10 SL @ 1.0 l/ha	1.76(2.60)	1.00(0.50)	1.32(1.25)	3.08(9.00)
Rynaxypyre 20 EC @ 100 ml/l +Quizalophop ethyl 5 EC @ 1.0 l/ha	1.82(2.80)	0.95(0.40)	1.41(1.50)	2.95(8.25)
Indoxacarb 14.5 EC @ 300 ml/ha +Imazathapyr 10 SL @ 1.0 l/ha	1.84(2.90)	0.95(0.40)	1.58(2.00)	2.12(4.00)
Indoxacarb 14.5 EC @ 300 ml/ha+Quizalophop ethyl 5 EC @ 1.0 l/ha	1.45(1.60)	1.00(0.50)	1.41(1.50)	2.29(4.75)
Quinolphos 25 EC @ 1.5 l/ha +Imazathapyr 10 SL 1.0 l/ha	1.87(3.00)	1.00(0.50)	1.58(2.00)	2.34(5.00)
Quinolphos 25 EC @ 1.5 l/ha +Quizalophop ethyl 5 EC @ 1.0 l/ha	1.73(2.50)	0.95(0.40)	1.50(1.75)	2.50(5.75)
Untreated check	1.76(2.60)	1.10(0.70)	2.00(3.50)	3.12(9.25)
SEm (±)	0.05	0.03	0.04	0.09
CD (P=0.05)	0.16	NS	0.13	0.26

Note:-Figures in the parentheses are original values; data were transformed through $\sqrt{x+0.5}$ which are given in bold,Sucking pest including jassid, aphid and white fly.(DAT = Day after treatment)

Table 2: Effect of herbicide and insecticide on weed count, weed dry matter and WCE in soybean

Treatments	Convolvulus arvensis (No/m²) at 30 DAT		(g m⁻²) at 30 DAT		Celosia argentea (No/m²) at 30 DAT		(g m⁻²) at 30 DAT		Total weed control efficiency (%)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Rynaxypyre 20 EC @ 100 ml/ha	1.58 (2.0)	1.37 (1.4)	1.73(2.50)	1.67 (2.3)	1.22 (1.0)	1.87 (3.0)	3.84(14.26)	2.20 (4.35)	13.74	-4.44
Indoxacarb 14.5 EC @ 300 ml/ha	1.87(3.0)	1.44 (1.6)	2.21(0.23)	1.79 (2.7)	1.58 (2.0)	1.79 (2.7)	3.72 (13.35)	1.95 (3.29)	13.52	-6.44
Quinolphos 25 EC @ 1.5 l/ha	2.12(4.0)	1.48 (1.7)	0.91(0.33)	1.73 (2.5)	2.12(4.0)	1.84 (2.9)	3.77 (13.75)	2.21 (4.41)	0.33	4.07
Imazathapyr 10 SL @ 1.0 l/ha	0.7(0.0)	0.7 (0.0)	0.7(0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0)	0.7(0.0)	94.81	99.59
Quizalophop ethyl 5 EC @1.5 l/ha	0.7(0.0)	0.7 (0.0)	0.7(0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0)	0.7(0.0)	78.58	93.97
Rynaxypyre 20 EC @ 100 ml/ha + Imazathapyr 10 SL @ 1.0 l/ha	0.7(0.0)	0.7 (0.0)	0.7(0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0)	0.7(0.0)	89.79	97.09
Rynaxypyre 20 EC @ 100 ml/l + Quizalophop ethyl 5 EC @ 1.0 l/ha	0.7(0.0)	0.7 (0.0)	0.7(0)	0.7(0.0)	1.58 (2.0)	1.22 (1.0)	2.88(7.79)	0.80 (0.15)	71.40	97.93
Indoxacarb 14.5 EC @ 300 ml/ha + Imazathapyr 10 SL @ 1.0 l/ha	1.58(2.0)	0.7 (0.0)	1.73(2.51)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0)	0.7(0.0)	94.11	95.15
Indoxacarb 14.5 EC @ 300 ml/ha + Quizalophop ethyl 5 EC @ 1.0 l/ha	0.7(0.0)	0.7 (0.0)	0.7(0)	0.7(0.0)	0.7(0.0)	1.22 (1.0)	0.7(0)	0.78 (0.11)	81.60	95.15
Quinolphos 25 EC @ 1.5 l/ha + \Imazathapyr 10 SL 1.0 l/ha	0.7(0.0)	0.7 (0.0)	0.7(0)	0.7(0.0)	0.7(0.0)	0.7(0.0)	0.7(0)	0.7(0.0)	89.58	96.88
Quinolphos 25 EC @ 1.5 l/ha + Quizalophop ethyl 5 EC @ 1.0 l/ha	0.7(0.0)	0.7 (0.0)	0.7(0)	0.7(0.0)	0.7(0.0)	1.22 (1.0)	0.7(0)	0.76 (0.08)	84.57	92.61
Untreated check	2.12(4.0)	1.51 (1.8)	2.26(4.60)	1.82 (2.8)	2.12(4.0)	1.87 (3.0)	3.76(13.62)	2.26 (4.62)	-	-
SEm (±)	0.03	0.03	0.04	0.03	0.04	0.03	0.04	0.04	-	-
CD (P = 0.05)	0.10	0.09	0.11	0.10	0.12	0.10	0.12	0.13	-	-

Note:-Figures in the parentheses are original values; data were transformed through $\sqrt{x+0.5}$ which are given in bold, (DAT = Day after treatment)

Table 3: Effect of herbicide and insecticide on pods number, seed index, seed yield and economics in soybean

Treatments	Pods (No/plant)		Seed index (g/100 seeds)		Seed yield(kg/ha)		Net income (Rs. /ha)		B:C ratio	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Rynaxypyre 20 EC @ 100 ml/ha	45.40	50.00	10.99	10.64	1550	1615	36828	39124	1.88	1.97
Indoxacarb 14.5 EC @ 300 ml/ha	46.93	55.06	10.67	10.67	1513	1594	35785	38502	1.86	1.98
Quinolphos 25 EC @ 1.5 l/ha	47.93	56.41	11.29	10.81	1548	1650	37540	40909	1.99	2.14
Imazathapyr 10 SL @ 1.0 l/ha	61.40	70.16	11.36	11.21	2323	2364	63655	64781	3.09	3.11
Quizalophop ethyl 5 EC @1.5 l/ha	60.83	71.25	11.78	11.61	2201	2412	60026	67019	3.05	3.36
Rynaxypyre 20 EC @ 100 ml/ha + Imazathapyr 10 SL @ 1.0 l/ha	59.68	66.25	11.76	11.71	2205	2281	57938	59997	2.63	2.70
Rynaxypyre 20 EC @ 100 ml/l + Quizalophop ethyl 5 EC @ 1.0 l/ha	61.65	72.25	11.13	11.33	2247	2394	60387	65206	2.86	3.06
Indoxacarb 14.5 EC @ 300 ml/ha + Imazathapyr 10 SL @ 1.0 l/ha	58.48	71.50	11.56	11.46	2049	2459	52726	66767	2.44	3.06
Indoxacarb 14.5 EC @ 300 ml/ha + Quizalophop ethyl 5 EC @ 1.0 l/ha	52.53	68.75	11.31	11.34	2030	2304	52833	61713	2.55	2.95
Quinolphos 25 EC @ 1.5 l/ha + Imazathapyr 10 SL 1.0 l/ha	56.45	69.25	11.63	11.42	2254	2447	60524	66794	2.85	3.11
Quinolphos 25 EC @ 1.5 l/ha + Quizalophop ethyl 5 EC @ 1.0 l/ha	55.48	71.75	11.02	11.32	2255	2434	61417	67289	3.02	3.27
Untreated check	36.58	47.56	11.04	10.81	1521	1558	37270	38664	2.08	2.13
SEm (±)	1.42	2.71	0.36	0.22	138	71	-	--	-	
CD (P = 0.05)	3.99	7.6	NS	0.62	381	195	-	--	-	

Note:-Figures in the parentheses are original values; data were transformed through $\sqrt{x+0.5}$ which are given in bold, (DAT = Day after treatment)

highest seed yield (2459 kgha^{-1}),which was found at par with all the herbicidal treatment. The higher seed yield under this treatment were might be due to better efficacy of herbicide at initial stage of crop growth providing weed free environment to the crop. Similar results was also reported byVenkatesha *et al*. (2008), Goud *et al*. (2013)and Sangeetha *et al*. (2013).

Economics

Imazathapyr 10 SL @1.0 l ha^{-1} recorded highest net income (63655 ¹ ha^{-1}) and B : C ratio (3.09)in 2013 but in 2014,highest net income (67767 ¹ ha^{-1})was recorded under indoxacarb 14.5 EC @ 300 ml ha^{-1} + imazathapyr 10 SL @1.0 l ha^{-1} and B: C ratio (3.27)under Quinolphos 25 EC @1.5 l ha^{-1} + Quizalophop ethyl 5 EC @ 1.0 l ha^{-1}(Table 3). Similar results were also found by Amaregouda *et al*. (2013) and Jha *et al*. (2014).

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