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Research Article

EFFECT OF TANK MIX APPLICATION OF HERBICIDES AND INSECTICIDES ON WEEDS AND YIELD OF SOYBEAN

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Abstract- Field experiments were conducted at Department of Pulses, Tamil Nadu Agricultural University to evaluate the tank mix application of herbicides and insecticides on weeds and yield of soybean during *kharif* season of 2013 and 2014. Results showed that tank mix application of imazethapyr 10 SL @ 100 g/ha + Chlorantraniliprole 18.5% SC @ 100 ml/ha was found to be more efficient to control monocot and dicot weeds in soybean which recorded lowest weed density (46.7 No./m^2), dry weight (20.67 g/m^2) and higher weed control efficiency (77.2%) and it was closely followed by indoxacarb 14.5 SC @ 300 ml/ha along with imazethapyr 10 SL @ 100 g/ha. It also found superior in respect of various growth and yield attributes. Highest seed yield (1082 kg/ha) of soybean and maximum net return (₹ 15499/ha) and B:C ratio of 1.69 were received in imazethapyr 10 SL @ 100 g/ha + Chlorantraniliprole 18.5% SC @ 100 ml/ha. Based on the results, it can be concluded that tank mix application of imazethapyr or quizalofop-ethyl were compatible with insecticides of Chlorantraniliprole or indoxacarb can be recommended as an effective weed and pest management practices with respect to yield and profit of soybean.

Keywords- Chlorantraniliprole, Imazethapyr, Weed control efficiency, Yield, B:C ratio.

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Introduction

Soybean (*Glycine max* L.) in India has become a leading oilseed crop with 41.5 and 28.6% contribution towards the total oilseeds and edible oil production. Losses due to weeds have been one of the major limiting factors in soybean production [1]. Weeds compete with crop for light, moisture and nutrients and the early-season competition being the most critical. The reduction in yield of soybean ranged from 18 - 60 % depending upon the nature and intensity of weeds [2]. The magnitude of losses largely depends upon the composition of weed flora, period of weeds crop competition and its intensity. Costs on weed control are the largest variable cost in most of the crop cultivation [3]. Though the conventional method (hand weeding) of weed control is very effective, but due to high wages and non-availability of labour during the critical weeding period, the use of herbicides could be more effective and time saving [4]. Weeding is often done late, causing drastic losses in yield. Due to scarcity of labour at peak times of agricultural operations, different herbicides based weed management technologies have been developed and as an alternative and to be test verified [5]. Raising cost of labour and their non-availability also lead to the search for alternative methods such as herbicide and its offer the most effective, economical and practical way of weed management [6]. On other hand, to control the insect pests at critical stage is very difficult and need to apply the various insecticides to control the pest infestation and also loss the physical energy for spraying of chemicals, so farmers are going for combined application of herbicides and pesticides in order to save the time and to reduce the production cost. In this view, the present investigation was conducted to find out the best suitable combination of tank mix application of herbicides and insecticides to control weeds as well as insect pests in soybean with lower cost and higher grain yield.

Materials and Methods

Field experiments were conducted during *kharif* 2013 and 2014 at Millet Breeding Station, Department of Pulses, Tamil Nadu Agricultural University, Coimbatore. Twelve treatments were imposed in randomized block design and replicated thrice with plot size of 6 m x 2.7 m. The treatments consisting of either alone or in combination of two herbicides *viz.*, Imazethapyr 10 SL and Quizalofop ethyl 5 EC and three insecticides *viz.,* Chlorantraniliprole 18.5% SC, Indoxacarb 14.5 SC, Quinalphos 25 EC and unweeded check. The soil of the experimental field was red sandy loam type with low available nitrogen (191 kg/ha), medium in available phosphorus (10.3 kg/ha) and high available potassium (392 kg/ha) with pH of 8.0. The soybean (Co (Soy) 3) seeds were dibbled @ 50 kg/ha with a spacing of 30 cm x 10 cm. Recommended fertilizer dose of 20: 80: 40 kg NPK/ha through urea, single super phosphate and muriate of potash and $ZnSO_4$ 25 kg/ ha was applied uniformly as basal. Both of the herbicides and insecticides were tank mixed and uniformly applied at 10 DAS using knap sack sprayer fitted with a flat pan nozzle with 500 litre water/ha. For biometric observations were taken in randomly selected and tagged ten plants in each plot. Crop was harvested at maturity, threshed and plot-wise seed and yields in kg/ha was recorded. The density of predominant individual weeds of grasses, sedges and broad leaved weeds and total weed density in each plot were recorded by using quadrant of 0.25 m^2 at four places randomly and expressed as number/m^2. Weed control efficiency was computed by adopting the formula suggested by [7].

$$WCE\ (\%) = \frac{WD_c - WD_t}{WD_c} \times 100$$

Where, WCE (%) - Weed control efficiency in percentage
WD_c - Weed density in control plot (No./m^2),

WD_t - Weed density in treated plot (No./m^2)

Data from individual experiment was pooled into one dataset and subjected to analysis of variance using as per standard method prescribed by [8].

Results and Discussions

Effect on weed parameters

In the experimental field, broad leaved weeds were dominated and accounts to 73% followed by grasses (16%) and sedges (11%). Major weed flora found in the experimental fields mainly consisted *Trianthema portulacastrum, Digeria arvensis, Gynanadropsis pentaphylla, Dactyloctenium aegyptium, Amaranthus viridis, Cynodon dactylon* and *Cyperus rotundus*. These weed flora are in line with the findings of [2].

Imazethapyr 10 SL @ 100 g/ha + Chlorantraniliprole 18.5% SC @ 100 ml/ha recorded lower weed density (40.6/m^2) and weed dry weight (43.4 g/ha) and it was comparable with tank mix application of imazethapyr 10 SL @ 100 g/ha along with indoxacarb 14.5 SC @ 300 ml/ha [Table-1]. The experimental site was dominated by broad leaved weeds and its effectively controlled by better performance of imazethapyr and due to responsible for inhibition of acetolactate synthase (ALS) or acetohydroxyacid synthase (AHAS) in broad leaf weeds which caused destruction of these weeds at 3-4 leaf stage [9].

Table-1 *Effect of tank mix application of herbicides and insecticides on weed characters of soybean*

S. No	Treatment	Weed density (No/m^2)	dry weight (g/m^2)	WCE (%)
T_1	Chlorantraniliprole 18.5% SC @ 100 ml/ha	154.0 (12.40)	69.00 (8.30)	24.1
T_2	Indoxacarb 14.5 SC @ 300 ml/ha	159.3 (12.60)	71.48 (8.44)	21.3
T_3	Quinalphos 25 EC @ 1.5 l/ha	165.7 (12.85)	73.65 (8.57)	18.9
T_4	Imazethapyr 10 SL @ 100 g/ha	54.3 (7.34)	24.23 (4.90)	73.3
T_5	Quizalafop ethyl 5 EC @ 1.0 l/ha	108.0 (10.38)	48.50 (6.95)	46.6
T_6	Imazethapyr 10 SL @ 100 g/ha (T4) + Chlorantraniliprole 18.5% SC @ 100 ml/ha (T1)	46.7 (6.76)	20.67 (4.51)	77.2
T_7	Quizalafop ethyl 5 EC @ 1.0 l/ha (T5) + Chlorantraniliprole 18.5% SC @ 100 ml/ha (T1)	98.0 (9.88)	44.00 (6.62)	51.6
T_8	Imazethapyr 10 SL @ 100 g/ha (T4) + Indoxacarb 14.5 SC @ 300 ml/ha (T2)	49.0 (6.96)	21.60 (4.63)	76.2
T_9	Quizalafop ethyl 5 EC @ 1.0 l/ha (T5) + Indoxacarb 14.5 SC @ 300 ml/ha (T2)	102.0 (10.07)	46.40 (6.75)	48.9
T_{10}	Imazethapyr 10 SL @ 100 g/ha (T4) + Quinalphos 25 EC @ 1.5 l/ha (T3)	52.3 (7.22)	23.48 (4.84)	74.2
T_{11}	Quizalafop ethyl 5 EC @ 1.0 l/ha (T5) + Quinalphos 25 EC @ 1.5 l/ha (T3)	106.3 (10.28)	47.67 (6.89)	47.5
T_{12}	Untreated check	203.0 (14.24)	90.85 (9.53)	-
	SEd	**0.66**	**0.46**	-
	CD (P=0.05)	**1.34**	**0.91**	-

Figures in parenthesis are square root transformed value

The maximum weed control efficiency of 77.2% [Table-2] observed with tank mix application of imazethapyr 10 SL @ 100 g/ha + Chlorantraniliprole 18.5% SC @ 100 ml/ha and it was closely followed by application of imazethapyr 10 SL @ 100 g/ha along with indoxacarb 14.5 SC @ 300 ml/ha. This might be due to greater reduction of wide spectrum of grasses and broad leaved weeds at early stages of crop growth reduced the biomass and ultimately the more weed control efficiency. Similar finding was also reported by [10]. Drastically maximum grass, sedge and broad leaved weed density and dry weight were observed with untreated plot. The results were in agreement with the findings of [1].

Table-2 *Effect of tank mix application of herbicides and insecticides on growth, yield parameters and net returns of soybean*

S. No	Treatment	Branches /plant	Pods/ plant	Seed index (g)	Seed yield (kg/ha)	Net return (Rs/ha)	B:C ratio
T_1	Chlorantraniliprole 18.5% SC @ 100 ml/ha	4.65	13.23	12.38	570	-721	0.97
T_2	Indoxacarb 14.5 SC @ 300 ml/ha	4.62	12.50	12.10	512	-2700	0.87
T_3	Quinalphos 25 EC @ 1.5 l/ha	4.60	11.88	12.05	465	-3811	0.81
T_4	Imazethapyr 10 SL @ 100 g/ha	4.80	23.30	13.40	1004	14217	1.68
T_5	Quizalafop ethyl 5 EC @ 1.0 l/ha	4.69	17.50	12.60	754	5567	1.27
T_6	Imazethapyr 10 SL @ 100 g/ha (T4) + Chlorantraniliprole 18.5% SC @ 100 ml/ha (T1)	5.00	25.11	13.85	1082	15499	1.69
T_7	Quizalafop ethyl 5 EC @ 1.0 l/ha (T5) + Chlorantraniliprole 18.5% SC @ 100 ml/ha (T1)	4.75	19.61	13.21	845	7304	1.33
T_8	Imazethapyr 10 SL @ 100 g/ha (T4) + Indoxacarb 14.5 SC @ 300 ml/ha (T2)	4.98	24.53	13.80	1057	14575	1.65
T_9	Quizalafop ethyl 5 EC @ 1.0 l/ha (T5) + Indoxacarb 14.5 SC @ 300 ml/ha (T2)	4.74	19.03	13.00	820	6380	1.29
T_{10}	Imazethapyr 10 SL @ 100 g/ha (T4) + Quinalphos 25 EC @ 1.5 l/ha (T3)	4.85	23.44	13.71	1010	13564	1.62
T_{11}	Quizalafop ethyl 5 EC @ 1.0 l/ha (T5) + Quinalphos 25 EC @ 1.5 l/ha (T3)	4.73	17.96	12.75	774	5404	1.25
T_{12}	Untreated check	3.80	7.80	11.00	308	-8043	0.57
	SEd	0.24	1.26	0.72	68	-	-
	CD (P=0.05)	0.50	3.06	1.41	140	-	-

Effect of growth and yield attributing characters

The maximum number of branches/plant (5.00), number of pods/plant (25.11) and seed index (13.85 g) were significantly recorded with imazethapyr 10 SL @ 100 g/ha + Chlorantraniliprole 18.5% SC @ 100 ml/ha [Table-2] which was meticulously comparable with imazethapyr 10 SL @ 100 g/ha along with indoxacarb 14.5 SC @ 300 ml/ha. This effective suppression of the weeds and also the better availability of all resources *viz.*, light, moisture, space and more nutrients to the crop plants at different stages put forth the higher plants. This is in

line with the findings of [3].

Imazethapyr 10 SL @ 100 g/ha + Chlorantraniliprole 18.5% SC @ 100 ml/ha recorded high seed yield of 1082 kg/ha [Table-2] which was comparable with tank mix application of imazethapyr 10 SL @ 100 g/ha along with indoxacarb 14.5 SC @ 300 ml/ha (1057 kg/ha). The early and quick control of weeds enabling crop plants to utilize moisture, nutrients and light sources in a better way. This enhanced the growth characters, yield attributes and the well balanced source sink ratio benefits the better utilization of inputs and the effective conversion of synthates accounted to the higher yield. These were in accordance with the earlier findings of [11].

Monetary returns

Economic analysis of data showed that imazethapyr 10 SL @ 100 g/ha + Chlorantraniliprole 18.5% SC @ 100 ml/ha registered higher net income (₹15499/ha) with B:C ratio of 1.69 [Table-2] and it was closely followed by imazethapyr 10 SL @ 100 g/ha along with indoxacarb 14.5 SC @ 300 ml/ha (Net income of ₹14575/ha and B:C ratio (1.65) respectively) and imazethapyr 10 SL @ 100g/ha+ quinalphos 25 EC @ 1.5 l/ha. The higher net return in these treatments was due to effective control of weeds in early stage, which reduced weed growth and gave higher yield attributes of soybean. The lowest net return and B:C ratio was recorded with weedy check on account of severe reduction in grain yield due to weed competition throughout the cropping period.

Conclusion

The results of the study revealed that, tank mix application of imazethapyr 10 SL @ 100g/ha or quizalafop ethyl 5 EC @ 50g/ha + Chlorantraniliprole 18.5% SC @ 100 ml/ha or indoxacarb 14.5 SC @ 300 ml were efficiently control the weeds, which was increased the seed yield of soybean and greater profit. Based on availability of tank mix with herbicides as well as insecticides to apply consistently to create weed free situation to crop weed competition for the conceivable production of soybean.

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Abbreviations

The following abbreviations are used

DAS: Days after sowing, @: at the rate, ₹: Indian Rupees, B:C; Benefit cost ratio, N: Nitrogen, P_2O_5: Phosphorus, K_2O: Potassium, WCE: Weed control efficiency, %: Per cent, WDc: Weed density in control plot (No/m^2), WDt: Weed density in treated plot (No/m^2), $ZnSO_4$: Zinc sulphate, No./m^2: Number per square meter, g/m^2: Gram per square meter, ml/ha: Milliliter per hectare, kg/ha: Kilogram per hectare, EC: Emulsifiable concentrate, SC: Soluble concentrate, SL: Soluble liquids.

Conflict of Interest: None declared

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