International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(5): 1869-1874

Received: 10-07-2017
Accepted: 11-08-2017

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Compatibility of herbicides mixed with insecticides in weed control under soybean (*Glycine max*. (L.) Merrill)

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Abstract
The study entitled "Compatibility of Herbicides Mixed with Insecticides in soybean (*Glycine max* (L.) Merrill)" was conducted in rainfed condition under "All India Co-ordinated Research Project on soybean at R.A.K. College of Agriculture, Sehore (M.P.), during kharif 2014. Experiment was laid out in randomized block design with three replications. The treatments included rynaxypyre 20SC @ 120g a.i./ha (T1), indoxacarb14.5SC @ 87g a.i./ha (T2), quinalphos25EC @ 150ga.i./ha (T3), imazethapyr10SL @ 100g a.i./ha (T4), quizalofop-p-ethyl 5EC @ 50g a.i./ha (T5), rynaxypyre 20SC @ 120g a.i./ha + imazethapyr10SL @ 100 ga.i/ha (T6), rynaxypyre 20SC @ 120g a.i/ha + quizalofop-p-ethyl 5EC @ 50 g a.i./ha (T7), indoxacarb14.5SC @ 87g a.i./ha+imazethapyr10 SL @100g a.i./ha(T8), indoxacarb14.5SC @ 87g a.i./ha +quizalofop-p-ethyl 5EC @50g a.i./ha (T9), quinalphos 25EC @ 150g a.i./ha + imazethapyr10 SL @ 100 g a.i./ha (T10), quinalphos 25EC @ 150g a.i./ha + quizalofop-p-ethyl 5EC @ 50g a.i./ha (T11) and untreated check (T12). Among the monocot weeds Echinochloa crusgalli Link., Degiteria sanguinalis, Dinebra arabica, *Cyperus rotundus* Linn. and *Commelina benghalensis* while the dicot weeds *Acalypha indica* Linn., Eclipta alba, *Caesulia axillaris* Roxb., *Digera arvensis*, Corchorous acutangulus and Phyllanthus niruri were observed in the field. Application of indoxacarb 14.5 SC @ 87 g ai/ha + imazathapyr 10 SL @ 100g ai/ha gave lowest weed dry weight and higher weed control efficiency (75.03%). Application of imazathapyr 10SL@ 100g ai/ha alone or in combination with insecticides viz. indoxacarb, rynyxypyre and quinolphos recorded less weed dry biomass and increased weed control efficiency, imazathapyr controlled both dicot and monocot weeds. Application of quizalofop-p-ethyl 5EC @ 50g ai/ha alone and in combination with insecticides effectively controlled the monocot weeds especially grasses viz. Echinochloa crusgalli Link. Degiteria sanguinali and Dinebra arabica.

Key words: Compatibility, Herbicides, Insecticides, monocot, dicot, weed control efficiency, Weed dry biomass.

1. Introduction
Soybean [Glycine max (L.) Merill] is recognized as 'Golden Bean' due to its high nutritional value such as high quality protein (40-45%), Oil (18-20%) and other nutrients like calcium, iron and glycine. Thus, rightly deserve the title of "WONDER CROP OF TWENTY CENTURY". Though the soybean plant is part of legume family, the UN Food and Agriculture Organization classifies it as an oilseed rather than a pulse. The low productivity of soybean both at national and state level is attributed to biotic and abiotic stresses like drought, weeds, insect-pests and disease. Among these weeds are also important biotic constraints in achieving higher soybean productivity. They are reported to cause yield loss up to 50% depending up on spacing, intensity and crop interaction (Chandel and Saxena, 1988, Singh, 2007) [1-7]. Soybean crop is highly prone to weed infestation which is a major cause of low productivity of soybean in India and it reduces the yield up to 20-89%. (Dubey, 2002) [2-9]. The major weed flora observed in the experimental plot were the following: *Echinochloa colona*, *Echinochloa crusgalli*, *Digitaria marginata*, *Digera arvensis*, *Eclipta alba*, *Amaranthus viridis*, *Parthenium hysterophorus*, *Commelina benghalensis*, *Altrnenthra philoxeroides*, *Phylanthus niruri and Cyperus rotundus.* Severe weed competition is one of the major constraints responsible for low productivity of soybean in Madhya Pradesh. Weeds are responsible for reduction in soybean yield and they lead to environmental degradation through destruction of native plants and diseases of crops, create unsafe conditions. In recent decades, the predominant weed control method in many parts of the world has been the use of effective and reliable chemical herbicides.

Herbicides are the most successful weed control technology ever developed as they are selective, cost effective, fairly easy to apply, have persistence that can be managed, and offer flexibility in application time. Although herbicides are a major factor contributing to world food production (Dixit and Choudhary, 2014) [3-8]. The crop yield losses are (25-33%) due to insect-pest. Being a highly proteineous crop, soybean is reported to be attacked by 273 spp. of insect, out of which two dozen are of economic significance (Rawat and Kapor, 1998) Among the recorded pest species, six species namely, hairy caterpillar, *Spilarctia oblique* (Walker); leaf roller, *Lamprosema indicata*; common cutworm, *Spodoptera litura*,pod borer, *Helicoverpa armigera* (Hubner); stem fly *Ophiomyia phaseoli* (Tryon) and white fly; *Bemisia tabaci* Genn. Were considered as the major pests while the rests were of minor importance on the basis of population densities per plant, nature and extent of damages, and yield reduction. Weed competition in soybean is 15-35 DAS and the some insect like girdle beetle, blue beetle and stem fly infestation is 25-30DAS.It is the crucial time of control of both weeds and insects. If insecticides and herbicides applied tank mixture it will save time, labour cost and equipment use. If insecticides and herbicides applied tank mixture it will save time, labour cost and equipment use. Mixture of herbicides and insecticides can be a useful tool in weed management especially kharif crops. Mixture may have important advantages, as the admixture of herbicides and insecticides can ofen be applied at much lower rates, especially when interacting synergistically (Gressel, 1990, Owenand Gressel, 2000). Application of compatible mixtures are more environmentally sound, less expensive and can control a broader spectrum of weed species than the continuous application of sole herbicides. Weed competition in soybean is 15-35 DAS and the some insect like girdle beetle, blue beetle and stem fly infestation is 25-30DAS. It is the crucial time of control of both weeds and insects. Hence present investigation was conducted to know the response of compatible herbicides and insecticides in weed intensity and weed control in soybean crop.

2. Materials and Method

The experiment was laid out in the Research Farm of R.A.K. college of Agriculture, Sehore (Madhya Pradesh) under, All India Coordinated Research Project on Soybean during Kharif 2014.The treatments included rynaxypyre 20SC @ 120g a.i./ha (T1), indoxacarb14.5SC @ 87g a.i./ha (T2), quinalphos25EC @ 150ga.i./ha (T3), imazethapyr10SL @ 100g a.i./ha (T4), quizalofop-p-ethyl 5EC @ 50g a.i./ha (T5), rynaxypyre 20SC @ 120g a.i./ha + imazethapyr10SL @ 100 ga.i/ha (T6), rynaxypyre 20SC @ 120g a.i/ha + quizalofop-p-ethyl 5EC @ 50 g a.i./ha (T7), indoxacarb14.5SC @ 87g a.i./ha+imazethapyr 10 SL @100g a.i./ha (T8), indoxacarb14.5SC @ 87g a.i./ha +quizalofop-p-ethyl 5EC @50g a.i./ha (T9), quinalphos 25EC @ 150g a.i./ha + imazethapyr10 SL @ 100 g a.i./ha (T10), quinalphos 25EC @ 150g a.i./ha + quizalofop-p-ethyl 5EC @ 50g a.i./ha (T11) and untreated check (T12). The variety JS 95-60 has been selected for experiment it was developed by J.N.K.V.V. Jabalpur (M.P.) by simple selection from PS 72-73. The plants are 45-50 cm tall and lenciolate leaves. It completes flowering in early 32-34 days, flowers are purple in colour. Physiological maturity attained in 82-89 days (extra early). The grain yield of this genotype is 20-22 q/ha with seed index of 12-13 g. The experimental observations are Weed flora, Weed occurrence and intensity, Weed biomass, Weed control efficiency.

2.1. Soil

The soil of the experiment field was medium black clay loam in texture fairly deep having a slight slope from west to east, which provides good drainage. Soil sample were collected randomly from different places of the field at 0-30 cm depth to access the initial fertility status of the soil of experimental field with the help of a screw type soil auger. After this a composite sample was prepared for the analysis of organic carbon, available nitrogen, phosphorus, potassium, pH and electric conductivity. The analytical values of soil pH 7.78. The initial soil test results were N 220.4 kg/ha available P12.60kg/ha and available K480.60 kg/ha. Experiment was laid out in randomized block design with three replications.

2.2. Climate and weather condition

Sehore is situated in the eastern part of Vindhyan Plateau in sub- tropical zone at the latitude of 23^0 12' North and longitude of 77^0 05' East at an latitude of 498.77 m above mean sea level in Madhya Pradesh. The average rainfall varies from 1000 to1200 mm concentrated mostly from June to September. The mean annual maximum and minimum temperature are 31.16^0C and 18.5^0 C, respectively. The summer months are hot and May is the hottest month having a maximum temperature up to 45.60^0C. Winter month experienced mild cold with an average temperature from 16.56^0 C to 8.74^0 C, December is the coldest month as temperature reaches up to 5^0 C. during the crop season total rainfall was 669.5 mm concentrated in 49 rainy days with maximum and minimum rainfall, ranged from 143.0 mm to 0.5 was observed in 35th and 37th and 38th meteorological standard week, respectively. The maximum temperature ranged from 42.38^0_C to 28.14^0_C was observed in 23th and 37th meteorological standard week, respectively, and the minimum temperature ranged from 17.28^0_C to 29.82^0_C was observed in 43th and 23rd meteorological standard week, respectively, while, the maximum relative humidity of 88.85 per cent was observed in 24th meteorological week and the minimum relative humidity of 64.80 per cent was recorded in 30th meteorological week.

3. Results & Discussion

3.1. Dominant weed flora and density

The major weeds of experimental field were monocot and dicot weeds among monocot weeds *Echinochloa crusgalli Link. Degiteria sanguinalis, Dinebra arabica, Cyperus rotundus Linn. Commelina benghalensis*, and dicot weeds *Acalypha indica Linn. Eclipta alba, Caesulia axillaris Roxb., Digera arvensis, Corchorous acutangulus* and *Phyllanthus niruri*. Weed density was recorded in weedy plot on 20 DAA stage is presented in table 1 *Degiteria sanguinalis, Caesulia axillaris, Dinebra arabica, Commelina benghalensis, Cyperus rotundus* Linn., *Corchorous acutangulus, Digera arvensis, Phyllanthus niruri* with 30.34, 25.89, 23.81, 17.10, 11.04, 3.28, 1.14, 1.01and 0.58 per cent share respectively.

Table 1: Dominant weed flora

S. No	Name of weeds	Weed density (no/m^2)	Relative density (%)
1	*Echinochloa crusgalli*	18.33	41.8
2	*Commelina benghalensis*	3.67	11.04
3	*Degiteria sanguinalis*	11.33	25.89
4	*Dinebra arabica*	8.33	17.1
5	*Cyperus rotundus* Linn.	5.35	3.28
	Total monocot weeds	47.01	99.11
a)	*Acalypha indica*	10.17	30.98
b)	*Eclipta alba*	11.33	30.34
c)	*Caesulia axillaris*	7.67	23.81
d)	*Digera arvensis*	5.33	1.01
e)	*Corchorous acutangulus*	3	1.14
f)	*Phyllanthus niruri*	2.17	0.58
	Total dicot weeds	39.67	87.89
	Total weeds	86.68	93.5

3.2. Weed intensity

3.2.1 Dicot weeds

It is evident from data given in table 2.The Effect of various weed control treatments on total weed intensity was analyzed statistically and variation was observed significant at all observation stages.10 DAA intensity of total dicot weeds were minimum under alone application of imazathapyr10SL @ 100 g ai/ha (T_4) and mixed application of indoxacarb14.5SC @ 87 g ai/ha + imazathapyr10SL @ 100 g ai/ha (T_8) which was at par with rynyxypyre20SC @120 g ai/ha + imazathapyr10SL @ 100 g ai/ha (T_6) At 20 DAA stage, the dicot weed count was minimum under application of indoxacarb14.5SC @ 87 g ai/ha + imazathapyr10SL @ 100 g ai/ha (T_8) and it was at par with alone application of imazathapyr10SL @ 100 g ai/ha (T_4), rynyxypyre20SC @ 120 g ai/ha + imazathapyr10SL @ 100 g ai/ha (T6) and quinolphos25EC @ 150 g ai/ha + imazathapyr10SL@100 g ai/ha (T_{10}). At 30 DAA,significant low weed intensity was noticed in alone application of imazathapyr10SL @ 100g a.i./ha (T_4). It was at par with treatment rynyxypyre20SC @ 120 g a.i./ha + imazathapyr10SL @ 100g ai/ha (T_6), indoxacarb14.5SC @ 87 g ai/ha + imazathapyr10SL @ 100 g ai/ha (T_8) and quinolphos25EC @ 150 g ai/ha + imazathapyr10SL @ 100 g ai/ha (T_{10}). The highest and almost similar population of dicot weeds was observed in alone application of herbicide quizalofo-p-ethyl5EC @ 50g ai/ha (T_5), insecticides treatment and untreated check at all observation stages. The intensity of total dicot weeds was minimum in alone application of imazathapyr 10 SL @ 100 g ai/ha and it was significantly better than all the treatments to control the dicot weeds. Similar results were also reported by Singh *et.al.* (2006) [19] and Tiwari *et.al.* (2007) [20]. The population of dicot weeds was also controlled with combined application of quinolphos 25 EC @ 150 g ai/ha + imazathapyr 10 SL @ 100 g ai/ha (Barkhade *et.al.* 2013) [5]. The effect of imidazolinones group of herbicides viz. imazathapyr either translocated through xylem and phloem or directly absorbed from the soil had specific action in suppressing the weed population of various species, The herbicide interfered with the adventitious bud - dormancy mechanisms and caused quiescent buds to become active. (Robert *et.al.* 1994) [13]. Individual population of dicot weeds viz, *Acalypha indica, Eclipta alba, Caesullia axillaris* recorded in experiment was also observed minimum in alone application of imazathapyr 10 SL@100g ai/ha followed by combined application of indoxacarb 14.5 SC @ 87 g ai/ha + imazathapyr 10 SL @ 100g ai/ha. Similar result was observed by Koshta *et. al.* (2011).

Table 2: Density of total dicot weeds in 1m^2 at different stages influenced by various treatments.

S. NO.	Treatments	g a.i./ha	10 DAA	20 DAA	30 DAA
Insecticides					
T_1	Rynyxypyre20SC	120	14.33(3.85)	27.00(5.24)	25.67(5.12)
T_2	Indoxacarb14.5SC	87	15.67(4.01)	26.67(5.18)	27.33(5.27)
T_3	Quinolphos25EC	150	13.67(3.76)	26.67(5.21)	25.67(5.11)
Herbicides					
T_4	Imazathapyr10SL	100	8.00(2.91)	10.00(3.24)	8.33(2.97)
T_5	Quizalofo-p-ethyl5EC	50	15.00(3.94)	29.67(5.49)	27.33(5.27)
Insecticides + Herbicides					
T_6	Rynyxypyre20SC+ Imazathapyr10SL	120+100	8.33(2.97)	10.33(3.29)	9.33(3.13)
T_7	Rynyxypyre20SC+ Quizalofo-p- ethyl5EC	120+50	15.33(3.98)	23.67(4.92)	24.33(4.98)
T_8	Indoxacarb14.5SC+ Imazathapyr10SL	87+100	8.00(2.91)	9.67(3.18)	9.33(3.13)
T_9	Indoxacarb14.5SC+ Quizalofo-p-ethyl5EC	87+50	15.67(4.02)	27.00(5.23)	25.00(5.05)
T_{10}	Quinolphos25EC+ Imazathapyr10SL	150+100	10.00(3.24)	12.33(3.58)	9.67(3.19)
T_{11}	Quinolphos25EC+ Quizalofo-p-ethyl5EC	150+50	15.67(4.02)	27.67(5.30)	24.00(4.95)
T_{12}	Untreated check		16.33(4.10)	29.67(5.49)	27.33(5.27)
	S. Em ±		-0.09	-0.17	-0.06
	C.D at 5%		-0.28	-0.5	-0.2

3.2.2 Monocot weeds

A perusal of table 3 revealed that the population of monocot weeds at 10 DAA and 20 DAA stages were recorded minimum under alone application of quizalofo-p-ethyl5EC @ 50 g ai/ha (T_5) and it was at par with treatments rynyxypyre20SC @ 120 g ai/ha + quizalofo-p-ethyl5EC @ 50 g ai/ha (T_7), indoxacarb14.5SC @ 87 g ai/ha + quizalofo-p-ethyl5EC @ 50 g ai/ha (T_9), quinolphos25EC @150 g ai/ha + quizalofo-p-ethyl5EC @ 50 g ai/ha (T_{11}), alone application of imazathapyr10SL @ 100g a.i./ha(T_4) and indoxacarb14.5SC @ 87 g ai/ha + imazathapyr10SL @ 100 g ai/ha (T_8). At 30 DAA stage, the monocot weed count was gave significantly better result under application of quizalofo-p-ethyl5EC @ 50 g ai/ha (T_5) then treatments T_1, T_2, T_3 and T_{12} but it was at par with all herbicidal treatments applied alone or in combination with insecticides. All the weed control treatments applied with quizalofop-p-ethyl significantly reduced the density of monocot weeds during the crop season. Similar finding were obtained by Mundra and Maliwal (2012). Application of quinolphos 25EC @150g ai/ha + quizalofop-p-ethyl 5EC @ 50 g ai/ha also reduced the population of monocot weeds in soybean. Similar finding reported by Barkhade *et.al.* (2013) [5]. The individual population of *Echinocloa crusgalli* link was minimum in alone application of quizalofop-p-ethyl 5EC @

50g ai/ha. Vidrine *et. al*. (1995) [21], Kushwah and Vyas (2005) [12] were also opinion that quizalofop-p- ethyl had effective control of barnyard grass. Similarly the population of *Commelina benghalensis* was also reduced by alone application of quizalofop-p- ethyl 5EC @ 50 g ai/ha. (Halvankar *et. al.* 2005) [10].

Table 3: Density of total monocot weeds in $1m^2$ at different stages as influenced by various treatments.

S. NO.	Treatments	g a.i./ha	10 DAA	20 DAA	30 DAA
Insecticides					
T_1	Rynyxypyre20SC	120	38.33(6.16)	43.00(6.59)	36.33(6.06)
T_2	Indoxacarb14.5SC	87	36.67(6.05)	44.00(6.67)	34.00(5.87)
T_3	Quinolphos25EC	150	35.00(5.90)	42.33(6.54)	36.67(6.09)
Herbicides					
T_4	Imazathapyr10SL	100	19.33(4.45)	15.33(3.97)	15.67(4.02)
T_5	Quizalofo-p-ethyl5EC	50	16.00(4.06)	10.33(3.23)	13.33(3.72)
Insecticides+ Herbicides					
T_6	Rynyxypyre20SC + Imazathapyr10SL	120+100	25.33(5.08)	16.67(4.14)	18.33(4.34)
T_7	Rynyxypyre20SC + Quizalofo-p- ethyl5EC	120+50	17.33(4.22)	10.33(3.23)	14.33(3.85)
T_8	Indoxacarb14.5SC + Imazathapyr10SL	87+100	22.33(4.77)	15.33(3.98)	17.00(4.18)
T_9	Indoxacarb14.5SC + Quizalofo-p-ethyl5EC	87+50	18.00(4.30)	10.67(3.34)	13.67(3.76)
T_{10}	Quinolphos25EC + Imazathapyr10SL	150+100	23.67(4.92)	16.67(4.12)	16.33(4.05)
T_{11}	Quinolphos25EC + Quizalofo-p-ethyl5EC	150+50	18.67(4.38)	11.33(3.44)	15.33(3.97)
T_{12}	Untreated check		43.67(6.65)	44.67(6.72)	41.67(6.49)
	S. Em ±		-0.28	-0.23	-0.17
	C.D at 5%		-0.82	-0.7	-0.53

3.4. Total weeds

It is obvious from the data given in table 4. Total weed intensity was significantly varied due to treatments at different stages. At 10 and 20 DAA minimum population of weeds was found in application of indoxacarb14.5SC @ 87g ai/ ha+ imazathapyr10SL @ 100 g ai/ha (T_8) which was at par with application of rynyxypyre20SC @ 120 g ai/ha + imazathapyr10SL @ 100 g ai/ha (T_6), alone application of imazathapyr10SL @ 100 g ai/ha (T_4), quinolphos25EC @150g ai/ha + imazathapyr10SL @ 100 g ai/ha(T10) and at 10 DAA rynyxypyre20SC @120 g ai/ha + quizalofo-p-ethyl5EC @ 50 g ai/ha(T_7). At 30 DAA indoxacarb14.5SC @ 87g ai/ha + imazathapyr10SL @100 g ai/ha (T_8) recorded less weed count it was at par with alone application of imazathapyr 10 SL @100 g ai/ha (T_4), rynyxypyre20SC @ 120 g ai/ha + imazathapyr10SL @ 100 g ai/ha (T_6) and quinolphos25EC @150g ai/ha + imazathapyr10SL @ 100 g ai/ha (T_{10}). The maximum total weed count was found in untreated check and it was similar under alone insecticide treated treatments at all observation stages.The effect of total weed population in various weed control treatments was found significantly minimum at all stages. Application of indoxacarb 14.5SC @ 87 g ai/ha + imazathapyr 10 SL @ 100 g ai/ha and rynyxypyre20 SC @ 120 g ai/ha+ imazathapyr 10 SL @ 100 g ai/ha recorded less population of weeds. John *et.al.* (1989) [11], Basu and Sangupta, (2011) [6] were also an opinion that the application of imazathapyr gave effective control of weeds.

Table 4: Density of total Weeds in $1m^2$ at different stages as influenced by various treatments.

S. NO.	Treatments	g a.i./ha	10 DAA	20 DAA	30 DAA
Insecticides					
T_1	Rynyxypyre20SC	120	52.67(7.22)	70.00(8.40)	62.00(7.90)
T_2	Indoxacarb14.5SC	87	55.37(7.47)	71.00(8.46)	61.33(7.86)
T_3	Quinolphos25EC	150	49.00(7.05)	69.00(8.33)	62.33(7.92)
Herbicides					
T_4	Imazathapyr10SL	100	27.00(5.24)	21.33(4.67)	23.00(4.85)
T_5	Quizalofo-p-ethyl5EC	50	40.33(6.38)	45.00(6.74)	43.00(6.59)
Insecticides + Herbicides					
T_6	Rynyxypyre20SC + Imazathapyr10SL	120+100	25.00(5.03)	21.00(4.61)	24.00(4.95)
T_7	Rynyxypyre20SC + Quizalofo-p- ethyl5EC	120+50	34.67(5.92)	40.33(6.39)	42.67(6.56)
T_8	Indoxacarb14.5SC + Imazathapyr10SL	87+100	24.67(5.01)	20.00(4.51)	22.00(4.74)
T_9	Indoxacarb14.5SC + Quizalofo-p-ethyl5EC	87+50	38.00(6.20)	42.33(6.51)	42.00(6.49)
T_{10}	Quinolphos25EC + Imazathapyr10SL	150+100	28.67(5.40)	23.33(4.88)	26.00(5.15)
T_{11}	Quinolphos25EC + Quizalofo-p-ethyl5EC	150+50	39.33(6.28)	46.67(6.87)	39.67(6.33)
T_{12}	Untreated check		60.00(7.75)	72.00(8.51)	69.00(8.34)
	S. Em ±		-0.35	-0.21	-0.18
	C.D at 5%		-1.03	-0.63	-0.55

3.5. Weed shoot biomass and Weed control efficiency

It is clear from the data given in table 5&6 that at 10 DAA stage combined application of indoxacarb14.5SC @ 87 g ai/ha + imazathapyr 10 SL @ 100 g ai/ha (T_8) recorded significantly less weed biomass and which was at par with alone application of imazathapyr 10 SL @ 100 g ai/ha (T_4), quinolphos25EC@150 g ai/ha + imazathapyr 10SL @ 100 g ai/ha (T_{10}) and rynyxypyre20SC @ 120gai/ha + imazathapyr10SL @ 100 g ai/ha (T_6). At 20 and 30 DAA stage less weed shoot biomass was found in alone application of imazathapyr 10 SL @ 100 g ai/ha (T_4). It was at par with combined application of indoxacarb14.5SC @ 87g ai/ha + imazathapyr 10 SL @ 100 g ai/ha (T_8), quinolphos25EC@150 g ai/ha + imazathapyr 10SL @ 100 g ai/ha (T_{10}) and

rynyxypyre20SC @ 120gai/ha + imazathapyr10SL @ 100 g ai/ha (T_6). Weed dry weight was highest and similar at all observation stages in insecticide treated treatments and untreated check. Weed control efficiency was minimum under application of insecticide indoxacarb14.5SC @87g ai/ha (T_2) at all stages of observation.The alone application of imazathapyr 10 SL @ 100 g ai/ha and its combination with insecticide indoxacarb 14.5 SC @ 87 g ai/ha recorded less weed shoot biomass. Sangeetha *et.al.* (2012) reported that the application of imazathapyr 10 SL @ 100g ai/ha reduced of weed dry weight and increase weed control efficiency. The favorable effect of herbicides on weed biomass and weed control efficiency was also reported by Halvankar e*t. al.* (2005) [10]. Weed control efficiency (WCE) at 10 DAA was highest in combined application of indoxacarb 14.5 SC @ 87 g ai/ha + imazathapyr 10 SL @ 100 g ai/ha. At 20 and 30 DAA weed control efficiency was recorded higher in alone application of imazathapyr 10 SL @ 100 g ai/ha.Similar results as in application of imazathapyr were also reported by Reddy *et.al.* (2013) and Kushwah and Vyas, (2005) [12]. The herbicide imazathapyr has arrested growth of most of the weeds, resulting in higher weed control efficiency and thus allowed the crop to grow more vigorously. Basu and Sengupta (2011) [6] reported that imazethapyr @1500 ml/ha herbicidal treatment recorded minimum weed density and weeds biomass and ultimately produced better yield.

Table 5: Weed shoot biomass (g)/m^2 as influenced by various treatments.

S. NO.	Treatments	g a.i./ha	10 DAA	20 DAA	30 DAA
	Insecticides				
T_1	Rynyxypyre20SC	120	46.00(6.82)	98.20(9.93)	86.67(9.34)
T_2	Indoxacarb14.5SC	87	47.17(6.90)	99.00(9.97)	87.33(9.37)
T_3	Quinolphos25EC	150	45.97(6.82)	95.97(9.82)	86.50(9.33)
	Herbicides				
T_4	Imazathapyr10SL	100	12.27(3.56)	41.83(6.51)	35.50(5.97)
T_5	Quizalofo-p-ethyl5EC	50	18.50(4.31)	59.83(7.76)	51.83(7.22)
	Insecticides + Herbicides				
T_6	Rynyxypyre20SC + Imazathapyr10SL	120+100	14.50(3.87)	44.83(6.73)	37.83(6.19)
T_7	Rynyxypyre20SC + Quizalofo-p- ethyl5EC	120+50	18.53(4.32)	55.83(7.50)	54.17(7.39)
T_8	Indoxacarb14.5SC + Imazathapyr10SL	87+100	12.00(3.53)	43.00(6.59)	37.17(6.13)
T_9	Indoxacarb14.5SC + Quizalofo-p-ethyl5EC	87+50	18.67(4.34)	59.17(7.71)	55.00(7.45)
T_{10}	Quinolphos25EC + Imazathapyr10SL	150+100	13.50(3.74)	43.87(6.66)	39.33(6.30)
T_{11}	Quinolphos25EC + Quizalofo-p-ethyl5EC	150+50	20.17(4.52)	55.67(7.49)	53.50(7.35)
T_{12}	**Untreated check**		48.07(6.92)	99.33(9.99)	87.83(9.40)
	S. Em ±		-0.22	-0.09	-0.21
	C.D at 5%		-0.66	-0.28	-0.62

Table 6: Weed control efficiency as influenced by various treatments.

S. NO.	Treatments	g a.i./ha	Weed Control Efficiency		
			10 DAA	20 DAA	30 DAA
Insecticides					
T_1	Rynyxypyre20SC	120	-	-	-
T_2	Indoxacarb14.5SC	87	-	-	-
T_3	Quinolphos25EC	150	-	-	-
Herbicides					
T_4	Imazathapyr10SL	100	74.47	57.88	59.58
T_5	Quizalofo-p-ethyl5EC	50	61.51	39.76	40.98
Insecticides + Herbicides					
T_6	Rynyxypyre20SC + Imazathapyr10SL	120+100	69.83	54.86	56.92
T_7	Rynyxypyre20SC + Quizalofo-p- ethyl5EC	120+50	61.45	43.79	38.32
T_8	Indoxacarb14.5SC + Imazathapyr10SL	87+100	75.03	56.7	57.67
T_9	Indoxacarb14.5SC + Quizalofo-p-ethyl5EC	87+50	61.16	44.62	32.63
T_{10}	Quinolphos25EC + Imazathapyr10SL	150+100	71.91	55.83	55.22
T_{11}	Quinolphos25EC + Quizalofo-p-ethyl5EC	150+50	58.04	43.95	39.08
T_{12}	**Untreated check**		-	-	-

4. Conclusion

It could be concluded that in the Soybean crop Compatible Herbicides and Insecticides were found very effective against weeds. Tank mixture of herbicides and insecticides reflects the effect of indoxacarb14.5SC@ 87 g ai/ha + imazathapyr10SL@100 g ai/ha and alone application of herbicide imazathapyr10SL@100 g ai/ha was found good effect and significantly control weed population and better Weed control efficiency.

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