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Evaluation of bio-efficacy of bio-stimulant (Macarena) along with herbicides on performance of soybean [*Glycine max* (L.) Merrill]

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Abstract

A discipline test entitled “evaluation of bio-efficacy of bio-stimulant (MACARENA) along side herbicides on overall performance of soybean [*Glycine max* (L.) Merrill]” become laid out at some point of the wet season 2019-20 at instructional cum research farm of IGKV, Raipur, Chhattisgarh. The test was specified in Randomized Block design with 7 remedies and 3 replications i.e. Sodium Acifluorfan (16.five%) + Clodinafop-propargyl 1 l (8% EC) @ a thousand MI/ha + MACARENA @ 625 ml/ha (T₁), Imazethapyr 10 SL @ 1000 ml/+ MACARENA @ 625 ml/ha (T₂), Fluazifop-p-butyl thirteen.four EC @ 2000 ml/ha + MACARENA @ 625 ml/ha (T₃), Propaquizafop 2.five% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha (T₄), MACARENA @ 625 ml/ha (T₅), hand weeding at 20 and 40 DAS (T₆) and Weedy check (T₇). The end result indicates that growth attributes viz, plant top, variety of branch, dry matter accumulation, crop increase charge, relative increase price in addition to yield attributes viz, number of pod plant⁻¹, number of seed pod⁻¹, Seed index (one hundred seed), Seed yield, Stover yield, harvest index have been discovered maximum beneath Sodium Acifluorfan (sixteen.five%) + Clodinafop-propargyl 1 l (8% EC) @ a thousand MI/ha + MACARENA @ 625 ml/ha (T₁) which become at par with Propaquizafop 2.five% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha (T₄). minimal values of above characters were discovered in Weedy test (T₇).

Keywords: Bio-stimulant and herbicides

1. Introduction

Soybean [*Glycine max* (L.) Merrill] is one of the most important oilseed plants inside the world and it's also known as wonder crop of the 20th century. it's far a most inexpensive supply of vegetable oil and protein. It carries approximately 40 percent protein, well balanced in critical amino acids, 18-20 according to cent oil wealthy with poly unsaturated fatty acids especially Omega 6 and Omega 3 fatty acids, 6-7 percentage overall mineral, five-6 percentage crude fiber and 17-19 percent carbohydrates. The protein first-class of soybean is equal to that of meat, milk merchandise and eggs and at the equal time wealthy in iron and nutrition C. as a result, it's miles well installed reality that soybean is a reasonably-priced source of protein and safe to eat oil. Soybean builds up the soil fertility through solving atmospheric nitrogen through the foundation nodules, and additionally thru leaf fall at the floor on adulthood. it can depart residual nitrogen impact for succeeding crop equivalent to 35-forty kg N ha⁻¹, Soybean can tolerate mild drought in addition to floods. This characteristic has made soybean to in shape nicely in sustainable agriculture. Soybean due to its diverse makes use of is rightly known as “Golden present” of nature to mankind.

Global soybean manufacturing in 2019-20 is anticipated as 333.sixty seven million tonnes from a complete area of 120.50 million hectares. Brazil ranks first in soybean manufacturing with 114.27 million tonnes observed with the aid of united states of the usa (ninety six.79 million tonnes), Argentina (55.26 million tonnes), China (15.73 million tonnes) and India (thirteen.27 million tonnes) accounting for 34.25, 29.01, 16.fifty six, four.00 and three.98 percent of global manufacturing. India ranks fourth in region with eleven.34 million hectares (28.02 million acres)

accounting for 9.41% of the sector area and 5th in production with 11.22 million tonnes (Soybean Outlook, October 2021, Agricultural market Intelligence Centre, PJTSAU).

Soybean is mainly grown in the course of kharif season in sandy loam to clay loam soils in Chhattisgarh. In those soils, with the aid of virtue of their water holding capacity, do now not flip up in running circumstance, hindering well timed weeding and interculture operation. Weed flush come at equal time in nearly all the kharif crops, which also restriction the availability of manpower for weeding operation in this crop. The untimely and bad weed control adversely affects proper increase and yield of soybean. The crucial period of crop weed opposition in soybean is stated to be first forty five DAS (Panneerselvam and Lourduraj, 2000) [8]. Weed infestation during early levels in soybean is one of the fundamental factors for loss in yield. The yield loss due to weed infestation in soybean changed into the music of 20-77 in step with cent (Kurchania *et al.* 2001) [6].

wide spectrum new herbicides are required to govern majority of weed plants in soybean crop. typically the farmer's use pre-plant incorporated and pre-emergence herbicides for weed control in soybean, however their efficacy are reduced by way of various climatic and edaphic elements. Hand weeding is a conventional and effective approach of weed manage, however untimely and continuous rains as well as unavailability of labour at height time are important limitations of guide weeding. The most effective opportunity that needs to be explored is the use of publish- emergence herbicides. The screening of such herbicides in soybean famous their efficiency in opposition to either monocotyledonous or dicotyledonous weeds. as a result, their mixtures might also increase the window of weed control through huge-spectrum weed manipulate (Bineet *et al.* 2001) [1].

2. Materials and strategies

The test become completed at educational cum studies Farm of IGKV, Raipur located at latitude of 21°04' N, longitude of 81°35' E and altitude of 290.2 m above imply sea stage with The climatic location of sub-humid to semi-arid. The supply of rainfall is south-west monsoon with common annual rainfall of 1326 mm (based on eighty years suggest). The experimental soil comes underneath Vertisols, impartial in pH (7.1), low in to be had nitrogen (220 kg ha⁻¹), medium in to be had phosphorus (12.54 kg ha⁻¹) and excessive to be had potassium (288 kg ha⁻¹). The experiment turned into laid out in randomized block layout (RBD) with 3 repetitions and the remedies include seven remedies i.e. Sodium Acifluarfan (sixteen. five%) + Clodinafop-propargyl 1 (eight% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha (T₁), Imazethapyr 10 SL@ one thousand ml/+ MACARENA @ 625 ml/ha (T₂), Fluazifop-p-butyl 13.4 EC @ 2000 ml/ha + MACARENA @ 625 ml/ha (T₃), Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha (T₄), MACARENA @ 625 ml/ha (T₅), hand weeding at 20 and 40 DAS (T₆) and Weedy check (T₇). The Soybean variety 'JS 97-52' changed into sown manually on 02 July 2019 with the spacing of 30 × 10 cm using a seed rate of 75 kg ha⁻¹. To save you the crop from soil and seed borne diseases, the seeds have been handled with bavistin @ 2 g kg⁻¹ of seeds accompanied by seed inoculation of seeds with *Rhizobium japonicum* @ 4 g kg⁻¹ seeds earlier than sowing. advocated dose of fertilizer i.e. 20:60:40 kg N: P₂O₅: K₂O ha⁻¹ was implemented through urea, single superb phosphate and muriate of potash as basal dose. All chemical substances were carried out as publish-emergence at 20 DAS. the required quantity of herbicide (Sodium Aciflorfan + Clodinofop

(Kover), Imazethapyr (Pursuit 10 SL), Fluazifop-p-butyl (Fusilade), Propaquizafop and MACARENA have been applied as per the remedies. The calculated above stated quantity of herbicide, as consistent with treatment, become mixed in 1.2 liter of water and sprayed over the gross plot with the aid of knapsack sprayer the usage of flat fan nozzle as blind application. in the treatment T₆ two hand weeding was done 20 and 40 DAS. because the crop was grown underneath rain-fed condition, no irrigation turned into carried out. The populace of the vegetation with 30 x 10 cm spacing became maintained through thinning manually after 10 DAS of emergence of seedlings in all the experimental plots. Plant populace changed into counted in keeping with meter row duration at preliminary and at harvest of crop. five plant life have been randomly decided on in every of the plot to report growth parameters *viz.*, plant height, no. of branches plant⁻¹, dry matter accumulation plant⁻¹ and leaf area plant⁻¹ at special boom stages i.e. 30, 60 DAS and at harvest. diverse yield attributing factors i.e. wide variety of pods plant⁻¹, number of seeds pod⁻¹, quantity of seeds plant⁻¹ and 100 - seed weight were recorded from five randomly tagged plant life. The seed and stover yield of crop have been weighed from net plot vicinity after harvesting and threshing of the crop. further the crop increase charge (CGR), relative increase price (RGR) and harvest index (hi) had been computed from the recorded facts and all statistics obtained from the test changed into statistically analyzed the usage of F- check, the manner given by using Gomez and Gomez, 1984 [3], vital difference (CD) values at P= zero.05 have been used to decide the importance of suggest differences of remedies.

3. Outcomes and dialogue

3.1 Growth Parameters

A good sized difference in increase parameters which include plant top, quantity of branches plant⁻¹, dry count number accumulation, crop increase fee and relative growth rate were found due to diverse weed management practices (desk 1).

T₁- Sodium Acifluarfan (16.5%) + Clodinafop-propargyl 1 (eight% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha produced considerably taller vegetation than rest of the treatment, however it changed into at par with T₄- Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha and T₆- hand weeding at 20 and 40 DAS. The shortest plant had been observed from T₇- weedy check.

The end result found out that remedy T₁- Sodium Acifluarfan (16.5%) + Clodinafop-propargyl 1 (eight% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha gave extensively better wide variety of branches than others. however it became on parity with T₄- Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha and T₆- two hand weeding at 20 and 40 DAS.

The dry count accumulation beneath T₁- Sodium Acifluarfan (16.5%) + Clodinafop-propargyl 1 (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha found highest which become at par with T₄- Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha and T₆- two hand weeding at 20 and forty DAS. lowest dry count number accumulation turned into recorded under T₇- weedy check.

Crop growth fee and relative boom price showed increasing trend as much as 60 DAS and declined there after till harvest. Numerically maximum values were acquired underneath T₁- Sodium Acifluarfan (16.5%) + Clodinafop-propargyl 1 (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha

determined maximum which turned into at par with T₄- Propaquizafop 2.5% EC + Imazethapyr three.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha and T₆- two hand weeding at 20 and forty DAS at 30 DAS. The minimal crop growth price became registered beneath T₇- weedy test.

The higher values of increase parameters in herbicide dealt with plots is probably because of the discount in crowding impact or weed populace among the crop plants, which facilitate more space, vitamins, light, and moisture and reduces the competition ultimately ensuing in greater wide variety of branches plant⁻¹. these outcomes are conformlty with those suggested by using Vyas and Jain (2003) [9], Kushwah and Vyas (2005) [7] and Vyas and Kushwah (2008) [10].

3.2 Yield attributes

The variety of pods plant⁻¹, variety of seeds pods-1, no. of kernel rows cob-1 and a hundred- seed weight numerous considerably due to various herbicidal treatments (table 2).

The most quantity of pods plant⁻¹, quantity of seeds pods-1, one hundred- seed weight became referred to in remedy T₁- Sodium Acifluarfan (16.5%) + Clodinafop-propargyl I (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha which become statistically corresponding to T₄- Propaquizafop 2.5% EC + Imazethapyr three.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha. This was observed by using T₆- hand weeding at 20 and 40 DAS and T₂- Imazethapyr 10 SL @ 1000 ml/+ MACARENA @ 625 ml/ha. however, the minimum range of seeds pod⁻¹ changed into recorded in T₇- weedy test.

This result can be due to the much less opposition at crucial intervals of crop growth and better suppression of weeds, which

allowed the crop to develop their ability via soaking up sufficient vitamins, light, moisture and area which facilitate extra translocation of photosynthates in the direction of the reproductive elements in addition to presence of favourable agro-climatic condition due to removal of weeds, led to greater variety of pods plant⁻¹. comparable effects had been said with the aid of Kumar *et al.* (2001) [5], Vyas and Jain (2003) [9] and Kothawade *et al.* (2006) [4].

3.3 Yield

Records discovered that there's full-size impact on seed yield of soybean due to new herbicide utility (desk 3).data confirmed that treatment T₁- Sodium Acifluarfan (sixteen. Five %) + Clodinafop-propargyl I (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha resulted in extensively higher seed yield and stover yield, that is at par with T₄- Propaquizafop 2.5% EC + Imazethapyr three.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha and T₆- hand weeding at 20 and 40 DAS and T₂- Imazethapyr10 SL@ 1000 ml/+ MACARENA @ 625 ml/ha. the bottom yields have been recorded in T₇- weedy test.). A non-great variation became observed in harvest index because of software of various herbicides.

The higher yield in above treatments might be due to lesser weeds at some point of early crop boom period and supply higher yield attributes and pod yield which results in better seed stover yield. whilst, in weedy check reverse fashion become found and therefore, the lowest stover yield turned into cited below this treatment. similar findings had been said by way of Dhane *et al.* (2009) [2].

Table 1: Effect of various herbicide treatments on growth parameters of Soybean

Treatment	Growth parameters		
	Plant height (cm)	Number of branches plant ⁻¹	Dry matter accumulation (g plant ⁻¹)
T ₁ - Sodium Acifluarfan (16.5%) + Clodinafop-propargyl I (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha	81.53	3.33	32.23
T ₂ - Imazethapyr 10 SL@ 1000 ml/+ MACARENA @ 625 ml/ha	73.13	3.27	25.35
T ₃ - Fluazifop-p-butyl 13.4 EC @ 2000 ml/ha + MACARENA @ 625 ml/ha	73.13	3.20	23.87
T ₄ - Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha	79.07	3.30	31.14
T ₅ - MACARENA @ 625 ml/ha	72.93	2.93	23.62
T ₆ - Two hand weeding at 20 and 40 DAS	73.40	3.27	28.08
T ₇ - Weedy check	72.27	2.67	19.53
SE m±	1.78	0.19	0.66
CD (P=0.05)	5.28	0.58	1.97

Table 2: Effect of various herbicide treatments on yield attributing characters of Soybean

Treatment	Yield attributing characters		
	Pods plant ⁻¹ (No.)	Seed pod ⁻¹ (No.)	Seed index 100 seeds(g)
T ₁ - Sodium Acifluarfan (16.5%) + Clodinafop-propargyl I (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha	53.80	2.77	12.15
T ₂ - Imazethapyr 10 SL @ 1000 ml/+ MACARENA @ 625 ml/ha	49.53	2.33	11.23
T ₃ - Fluazifop-p-butyl 13.4 EC @ 2000 ml/ha + MACARENA @ 625 ml/ha	47.13	2.32	11.13
T ₄ - Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha	50.20	2.63	11.53
T ₅ - MACARENA @ 625 ml/ha	46.00	2.27	10.20
T ₆ - Two hand weeding at 20 and 40 DAS	49.60	2.57	11.44
T ₇ - Weedy check	45.80	2.23	9.98
SE m±	1.65	0.06	0.37
CD (P=0.05)	4.91	0.19	1.08

Table 3: Effect of various herbicide treatments on yields of Soybean

Treatment	Seed yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Harvest index (%)
T ₁ - Sodium Acifluorfan (16.5%) + Clodinafop-propargyl 1 (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha	1930	3870	33.28
T ₂ - Imazethapyr 10 SL @ 1000 ml/+MACARENA @ 625 ml/ha	1600	3560	31.01
T ₃ - Fluazifop-p-butyl 13.4 EC @ 2000 ml/ha +MACARENA @ 625 ml/ha	1470	3410	30.12
T ₄ - Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @2000 ml/ha + MACARENA @ 625 ml/ha	1830	3860	32.16
T ₅ - MACARENA @ 625 ml/ha	1350	2920	31.62
T ₆ - Two hand weeding at 20 and 40 DAS	1650	3280	33.47
T ₇ - Weedy check	411	804	33.83
SE m±	43	89	-
CD (P=0.05)	124	262	NS

Table 4: Economics of soybean as influenced by different weed control measures

Treatment	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net returns (Rs/h)	B:C ratio
T ₁ - Sodium Acifluorfan (16.5%) + Clodinafop-propargyl 1 (8% EC) @ 1000 ml/ha +MACARENA @ 625 ml/ha	88195	16785	71410	5.2
T ₂ - Imazethapyr 10 SL @ 1000 ml/+MACARENA @ 625 ml/ha	75485	16285	59200	4.6
T ₃ - Fluazifop-p-butyl 13.4 EC @ 2000 ml/ha +MACARENA @ 625 ml/ha	70275	15885	54390	4.4
T ₄ - Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @2000 ml/ha + MACARENA @ 625 ml/ha	84495	16785	67710	5.0
T ₅ - MACARENA @ 625 ml/ha	65235	15285	49950	4.2
T ₆ - Two hand weeding at 20 and 40 DAS	78835	17785	61050	4.4
T ₇ - Weedy check	27892	12685	15207	2.1
SE m±	-	-	-	-
CD (P=0.05)	-	-	-	-

4. Conclusion

The soybean (JS-9752) responded favorably to the Sodium Acifluorfan (sixteen.five%) + Clodinafop-propargyl 1 (eight% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha (T₁) treatment for attaining better boom attributes, in addition to grain and straw yield. combined application of two hand weeding at 20 and 40 DAS (T₆) is maximum appropriate for the minimization of total and species wise weed density and dry be counted accumulation of weeds.

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