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RESEARCH NOTE

Quality parameters and root nodules of soybean as influenced by weed management practices

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ABSTRACT

A field experiment was conducted at Agricultural Research Station, Ummedganj, Kota during rainy *(Kharif)*, 2019 to study the comparative efficacy of pre- and post-emergence herbicides in managing weeds and improving productivity and quality of soybean (*Glycine max* L. Merrill). The experimental field was infested with grassy weeds, broad-leaved weeds and sedges. Maximum number and dry weight of root nodules/plant recorded in hand weeding twice at 20 and 40 days after sowing (DAS) followed by application of acifluorfen-sodium 16.5% + clodinafop-propargyl 8% (pre-mix) 165 + 80 g/ha at 20 DAS, at 50 days after sowing. The lowest dry weight of root nodules/plant was recorded under weedy check. Significantly higher protein content and protein yield were recorded under two hand weeding at 20 and 40 DAS found maximum protein yield followed by application of acifluorfen-sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha at 20 DAS. Oil content in seeds was not significantly influenced by different weed control treatments whereas, oil yield was significantly enhanced by them over weedy check. Oil and protein yield are largely a function of seed yield. Strong positive correlation between oil, protein yield and seed yield support the fact. The data further revealed that two hand weeding at 20 and 40 DAS recorded maximum oil yield followed by application of acifluorfen-sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha at 20 DAS.

Keywords: Herbicides, Protein, Soybean, Oil, Root nodules, Yield

Soybean [*Glycine max* (L.) Merrill] is also known as golden/miracle/wonder bean crop because it contains 38–42% good quality protein, 18–20% oil, rich in polyunsaturated fatty acids, good amount of minerals (Ca, P, Mg, Fe and K) and vitamins especially B-complex and tocopherols. It provides high amounts of phyto-chemicals and good quality dietary fibre which enables to protect human body against cancers and diabetes (Chouhan 2007). Soybean plays a pivotal role in meeting the continuously increasing demand of the edible oil across the world; it contributes 25% in total edible oil production. Presently soybean is contributing 42 percent share of total oilseed and 22 percent to total edible oil production in the country (ICAR-IISR 2023). With increase in population the demand of edible oil is increasing and 40 percent of the demand is being fulfilled by different oilseed crops and rest 60 percent demand is being made up by import. The cost of import of edible oil put a high pressure on our foreign exchange. Among all the oilseed crops, soybean is having the highest potential to meet the challenge of being self-sufficient in production of edible oil. The national productivity of soybean (1.16 t/ha) is quite lower than the world average (2.76 t/ha).

Soybean is a rainy season crop and it faces severe crop weed competition during growth phases. Yield reductions in soybean due to poor weed management ranges from 12 to 85% depending on weed flora and their density (Nagaraju and Kumar 2009). Although weeds pose problems during the entire crop period but maintaining weed free condition during critical period (first 45 days after sowing) is very much essential (Hosmath 2014). Therefore, keeping in view the present study was undertaken to find out the effect of different weed management practices on root nodules and quality parameters of soybean.

The experiment was conducted at Agricultural Research Station, Ummedganj, Kota (Rajasthan), India during rainy *(Kharif)*, 2019. The experiment was laid out in randomized block design with eight treatments and three replications was used. Eight treatments include pre-emergence application (PE) of pendimethalin 1.0 kg/ha, pendimethalin 30% EC + imazethapyr 2% SL (pre-mix) 960 g/ha PE, post-

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emergence application (PoE) of acifluorfen- sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha at 20 DAS, quizalofop-ethyl 50 g/ha PoE at 20 DAS, imazethapyr 100 g/ha PoE at 20 DAS, imazethapyr 3.75% + propaquizafop 2.5% ME (pre-mix) 50 + 75 g/ha PoE at 20 DAS, hand weeding twice at 20 and 40 days after seeding (DAS) and weedy check. The soil of the experimental field was clay loam in texture and the soil having medium fertility status. Soybean variety RKS-113 (Kota Soya-1) was used as experimental material developed at ARS, Kota (Rajasthan).

The numbers of root nodules recorded by uprooting carefully five randomly selected plants and after washing root nodules were separated from the roots of the plants. The root nodules were dried in the sun then transferred to thermostatic controlled drying oven regulated at 80°C±2°C for 45 hours and dried up to a constant weight and finally their weight was recorded in mg with the help of electronic balance. Oil content in seeds from each net plot sample was determined by Soxhlet ether extraction method (AOAC 1965) expressed as per cent oil content in seed. Oil yield was worked out by multiplying the seed yield with oil content for each corresponding treatment.

Oil yield (kg/ha) = Oil content in seed (%) × seed yield (kg/ha)/100

The protein content in seed was calculated by multiplying per cent nitrogen in the seed by the factor 6.25 (Simson *et al*. 1965) and expressed as per cent protein content. Protein yield was worked out by formula;

Protein yield (kg/ha) = Protein content in seed (%) × seed yield (kg/ha)/100

Effect on root nodules

Data presented in **Table 1** showed that, the number of root nodules/plant recorded significantly higher in two hand weeding (50.80), which was at par with application of acifluorfen- sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha (46.37). Among herbicidal treatments, application of acifluorfen- sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha recorded higher number of root nodules/plant, which was at par with all herbicidal treatments.

Data further depicted in **Table 1** showed that at 50 DAS dry weight of root nodules/plant recorded significantly higher in two hand weeding (84.0 mg) which was superior over all herbicidal treatments. Among herbicidal treatments, application of acifluorfen- sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha (75.7 mg) recorded higher weight of root nodules/plant, which was at par with application of pendimethalin 30% EC 1.0 kg/ha (72.7 mg), application of imazethapyr 3.75% + propaquizafop 2.5% ME (pre-mix) 50 + 75 g/ha (72.0 mg) and application of quizalofop-ethyl 5% EC 50 g/ha at (71.7 mg) and closely followed by application of imazethapyr 10% SL 100 g/ha (71.0 mg) and application of pendimethalin 30% EC + imazethapyr 2% SL (pre-mix) 960 g/ha (70.3 mg). The minimum number (40.57) and lowest dry weight of root nodules/ plant was recorded under weedy check (64.0 mg).

The both parameters were higher in two hand weeding followed by application of acifluorfen-sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha. This variation in number and dry weight of root nodules in different treatments could be explained in terms of crop-weed competition for space, nutrient and light for less competition. Since the presence of more weeds in treatments will provide less Rhizospheric space for crop, which results in less effective nodules both quantitatively as well as qualitatively. The results are in agreement with the findings of Verma and Kushwaha 2019.

Table 1. Effect of weed management practices on number of nodules/plant, their dry weight at 50 DAS and oil, protein content in seed

Treatment	No. of nodules/plant	Dry weight of nodules (mg/plant)	Oil content (%)	Protein content (%)
Pendimethalin 30% EC 1.0 kg/ha as PE	44.47	72.7	19.80	39.06
Pendimethalin 30% EC + imazethapyr 2% SL (pre-mix) 960 g/ha as PE	42.70	70.4	19.93	40.10
Acifluorfen- sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha at 20 DAS	46.37	75.7	20.23	40.63
Quizalofop ethyl 5% EC 50 g/ha at 20 DAS	43.73	71.7	19.83	39.52
Imazethapyr 10% SL 100 g/ha at 20 DAS	42.93	71.0	19.87	39.90
Imazethapyr 3.75% + propaquizafop 2.5% ME (pre-mix) 50 + 75 g/ha at 20 DAS	43.93	72.0	20.00	40.31
Hand weeding at 20 and 40 DAS	50.80	84.0	20.37	41.04
Weedy check	40.57	64.0	19.67	38.02
LSD (p=0.05)	5.18	4.64	NS	1.73

Table 2. Effect of weed management practices on different quality parameters yield and economics of soybean

Treatment	Oil yield (kg/ha)	Protein yield (kg/ha)	Seed yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	B:C ratio
Pendimethalin 30% EC 1.0 kg/ha as PE	243	479	1225	1792	3017	1.07
Pendimethalin 30% EC + imazethapyr 2% SL (pre-mix) 960 g/ha as PE	294	592	1475	2128	3603	1.42
Acifluorfen- sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha at 20 DAS	313	630	1550	2233	3783	1.61
Quizalofop ethyl 5% EC 50 g/ha at 20 DAS	263	523	1325	1930	3255	1.24
Imazethapyr 10% SL 100 g/ha at 20 DAS	283	569	1425	2091	3516	1.47
Imazethapyr 3.75% + propaquizafop 2.5% ME (pre-mix) 50 + 75 g/ha at 20 DAS	304	613	1520	2190	3710	1.54
Hand weeding at 20 & 40 DAS	366	739	1800	2592	4392	1.22
Weedy check	138	267	700	1028	1728	0.26
LSD (p=0.05)	29.16	60.73	122.93	193.28	310.69	0.20

Effect on oil content and oil yield

A perusal of data (**Table 2**) revealed that all the weed control treatments were non-significantly influenced the oil content of soybean seed. The highest oil content (%) was recorded in two hand weeding (20.37%) and oil yield (366 kg/ha) followed by application of acifluorfen-sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha (20.23%) and oil yield (313 kg/ha), respectively. The minimum oil content (19.67%) and oil yield (138 kg/ha) was recorded under weedy check.

Oil yield is largely a function of seed yield. Oil yield was found to increase significantly due to weed control treatments. Strong positive correlation between oil yield and seed yield (r = 0.999**) support the fact. Two hand weeding at 20 and 40 DAS registered highest oil yield followed by application of acifluorfen- sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha, which was statistically at par with application of imazethapyr 3.75% + propaquizafop 2.5% ME (pre-mix) 50 + 75 g/ha at 20 DAS and application of pendimethalin 30% EC + imazethapyr 2% SL (pre-mix) 960 g/ha as pre-emergence and significantly superior over weedy check. The results are in agreement with the findings of Jadon *et al.* 2019.

Effect on protein content and protein yield

The data presented in **Table 2** revealed that significantly higher protein content and protein yield were recorded over weedy check by adopting various weed management practices. Protein yield was found to increase significantly due to weed management practices. Protein yield is largely a function of seed yield. Strong positive correlation coefficient value between protein yield and seed yield (r = 0.999**) support the fact. Hand weeding twice at 20 and 40 DAS was recorded highest protein content, which was statistically at par with application of acifluorfen-sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha. Data of **Table 2** further revealed that two hand weeding registered highest protein yield (739 kg/ha) followed by application of acifluorfen-sodium 16.5% + clodinafop-propargyl 8% EC (pre-mix) 165 + 80 g/ha (630 kg/ha), which was statistically at par with application of imazethapyr 3.75% + propaquizafop 2.5% ME (pre-mix) 50 + 75 g/ha (613 kg/ha) and application of pendimethalin 30% EC + imazethapyr 2% SL (pre-mix) 960 g/ha as pre-emergence (592 kg/ha) and significantly superior over weedy check (267 kg/ha). Jadon *et al*. 2019 was also reported highest protein yield under two hand weeding.

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