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Full Length Research Paper

Effect of imazethapyr and varying level of fertilizer on soybean crop quality

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ABSTRACT

Importance of soybean as a source as of protein and oil is well established. Protein and oil deposition in the crops was affected by many factors such as fertilizers, biofertilizers and organic inclusion. Thus experiment was conducted to adjudge the effect of imazethapyr and varying level of fertilizers on soybean grain quality with respect to oil and protein percentage applied in soybean crop under long-term fertilizer experiment. The maximum protein content (39.54 %) and oil content of 19.47 percent was observed in 100% NPK+ FYM+ imazethapyr treatment. While, the lowest value of protein and oil contents we recorded in T_7 (control + imazethapyr). The result of the study imply that the use of balance rate of minerals fertilizer in combination with organic manures along with herbicide must form part of soil management practices for the intensively cultivated soil to sustain soil health, productivity and crop quality.

Key words: Fertilizer, imazethapyr, protein and oil content, soybean

INTRODUCTION

Importance of soybean as a source of protein and oil is well established. Protein and oil deposition in the crops was affected by many factors such as fertilizers, biofertilizers and organic inclusion (Khajouei et al., 2004, Hyten et al., 2004). The supply of balance nutrient to the growing plant influenced the protein and oil metabolism (Bachhav and Sable 1996, Singh et al., 2003). As the supply of nutrient decreases the reduction of the plant-synthesis exhibited under such condition, which indicated that seed oil and protein yield of soybean increased with balance application of NPK (Bachhav and Sable, 1996), Soybean is extensively grown in all over Madhya Pradesh because of its wide adaptability to agro climatic conditions and high market value of the product. Intense weeds in soybean fields is one of the constituents limiting its higher productivity which causes reduction in yield varies from 35 to 50%, depending on type of weed their intensity and time of crop weed competition (Chandel and Sexena, 1988). Soybean oil commonly known as 'vegetable oil' does not contain cholesterol and much saturated fat. Soybean oil contains natural antioxidants, which remain in the oil even after extraction. These antioxidants help to prevent the oxidative rancidity.

Imezethhapyr is used in soybean and several other leguminous crops to control a wide spectrum of broad leaves and grassy weed species (Sondhia 2008). Imazethapyr is a selective herbicide of imidazolinone group and acts by reducing the level of three branched chains aliphatic amino acids viz. isoleucine, leucine and valine, through the inhibition of acetohydroxy acid synthase an enzyme common to the biosynthetic pathway for these amino acid (Sondhia 2008a). This inhibition causes the disruption in protein synthesis which in turn, leads to interference in DNA synthesis and cell growth. Imazethapyr persists longer in acidic than alkaline soil (Loux and Resse 1993). Imazethapyr dissipates by microbial degradation and photolysis under field condition (Stougaard et al., 1990). Imazethapyr is a weak acid (like amphoteric) having both carboxylic acid and pyridine functional groups dissociation to

the anion results very low sorption at high pH levels. The non-ionized form of acidic herbicides to dominant at pH below it pKa of 3.9 exhibits binding it more critical of non ionic herbicides at very low pH, imazethapyr can be promoted and sorbed on the soil by cation exchange. As a result the soil behavior of Imidazolinone has been sown to be affected by pH soil (Loux and Resse 1993, Sondhia 2008).

As varying level of herbicides affect soil pH and other physico-chemical properties due to presence of residues (Sondhia 2005, 2007, 2008b, 2008c, 2013), thus this study was conducted to adjudge the effect of imazethapyr and varying level of fertilizers on soybean grain quality with respect to oil and protein percentage applied in soybean crop under long-term fertilizer experiment.

MATERIAL AND METHODS

A field experiment was conducted in Kharif 2008 at research farm of Jawahar Nehru Vishva Vidyalaya, Jabalpur on a Vertisol. The soil of the experimental field is medium black belonging to Kheri series of fine montmorillonitic hyperthermic family of Typic Haplustert. The soil was clay loam in texture (clay 56.82%, silt 17.91% and sand 25.27%) with available nitrogen (193 kg/ha) phosphorus (7.6 kg/ha) and potassium (370 kg/ha) organic carbon(5.7 g/kg) EC(0.18 d/Sm) and pH (7.6).The experiment consists of 10 treatments replicated four times in a randomized block design. The gross plot size being 17 x 10.8 m with 1 m spacing in between the plots and 2 m spacing between the replications. The crop was raised under irrigated condition with recommended package of practices.

The recommended fertilizer dose (100% NPK) for soybean crop was applied on soil at the rate of 20:80:20 NPK respectively through Urea, SSP, DAP, and MOP. In treatments include T_1 (50% NPK), T_2 (100% NPK), T_3 (150% NPK), T_4 (100% NPK+ Hand Weeding), T_5 (100%NPK+Zn), T_6 (100% NP), T_7 (100% N), T_8 (100% NPK+ FYM), T_9 (100% NPK – S), and T_{10} (Control, no fertilizer). Imazethapyr was applied 25 days after sowing of soybean crop in all treatments at the rate of 100g ai ha^{-1} except T_4.

Estimation of protein content in soybean

Soybean plants were collected at harvest and processed for crude protein and oil content estimation. The protein content in the sample was determined by micro-kjeldahl digestion and distillation procedure using pelican's kel-plus digestion and distillation assembly as described in AOAC (1992). crude protein content was calculated using formula:

$$N\ (\%) = \frac{\text{Normality of } H_2SO_4 \times \text{Titrated value} \times 14}{\text{Weight of sample} \times 1000} \times 100 \quad \text{---------eq (1)}$$

$$\%\text{Protein} = \%\ N \times 6.25 \quad \text{----------eq (2)}$$

Estimation of oil content

The oil content in the sample (soybean seed) was estimated by Sochlet's extraction method as described in AOAC (1992). The oil content was determined as below:

$$\text{Oil}\ (\%) = \frac{(\text{Weight of flask with oil} - \text{Weight of empty flask})}{\text{Weight of sample}} \times 100 \text{---------eq (3)}$$

RESULTS AND DISCUSSION

Protein content:

The data on protein content suggested that under balanced fertilizer application the protein content of seeds was closely related to the N status of the soil, as well as the nitrogen concentration of the seeds. The protein content ranged from 34.81 to 39.54 percent and it was found that the successive additions of fertilizer progressively increased the protein content in soybean seeds. The maximum protein content (39.54 %) was observed in T8 (100% NPK+FYM+Imazethapyr) treatment. While, the lowest value of protein was recorded in T7 (control + imazethapyr) as well as control T10 (34.81%). Further protein content was found 38.18% due to application of 50% NPK+imazethapyr dose (T1). Protein content in T7 (100%N +imazethapyr) treatment was significantly lower than T3 (150% NPK+imazethapyr), where as the protein content estimation in T1, T5, T6 and T7 (50% NPK, 100% NPK+Zn 100% NP, and 100%NPK +S +imazethapyr) treatments were found to be statistically at par amongst themselves.

The soil status governed the nodulation and N fixation and thus uptake by the plant. Imbalance of nutrients also inhibited the N-fixing process by the rhizobium. Reduction in protein content (Table 1) was attributed to poor root growth and /or nodulation, resulting into poor N-fixation as well as less uptake of nitrogen in T_7 (100% N only) or T_{10} (control). In T_7, in spite of nitrogen application the protein yield was poor which might be attributed to the suppression of nitrogen availability due to imbalanced and the consequent deficiency of other nutrients elements.

In part of the deterioration in physical properties of the soil resulted in poor root growth and thereby less adsorption of nitrogen. Protein

Table 1. Protein content in soybean grain influenced by different treatments

Treatments		Protein (%)
T_1	50%NPK+ imazethapyr(100 g/ha)	38.18
T_2	100%NPK+ imazethapyr(100 g/ha)	38.36
T_3	150%NPK+ imazethapyr(100 g/ha)	39.30
T_4	100%NPK+Hand Weeding	38.24
T_5	100%NPK+Zn+ imazethapyr(100 g/ha)	38.06
T_6	100%NP+ imazethapyr(100 g/ha)	37.30
T_7	100%N+ imazethapyr(100 g/ha)	35.87
T_8	100%NPK+FYM+ imazethapyr(100 g/ha)	39.54
T_9	100%NPK – S + imazethapyr(100 g/ha)	37.16
T_{10}	Control + imazethapyr(100 g/ha)	34.81
SEm±		0.446
CD (p=0.05)		0.440
CV		1.903

Table 2. Oil content in soybean grain influenced by different treatments

Treatments		Oil (%)
T_1	50%NPK+ imazethapyr(100 g/ha)	16.37
T_2	100%NPK+ imazethapyr(100 g/ha)	17.57
T_3	150%NPK+ imazethapyr(100 g/ha)	18.54
T_4	100%NPK+Hand Weeding	17.53
T_5	100%NPK+Zn+ imazethapyr(100 g/ha)	18.40
T_6	100%NP+ imazethapyr(100 g/ha)	16.61
T_7	100%N+ imazethapyr(100 g/ha)	16.43
T_8	100%NPK+FYM+ imazethapyr(100 g/ha)	19.47
T_9	100%NPK – S + imazethapyr(100 g/ha)	18.71
T_{10}	Control + imazethapyr(100 g/ha)	16.20
SEm±		0.184
CD (p=0.05)		0.186
CV		1.383

content in T_6 and T_9 were also significantly lower than in T_2 and T_3. Sharma and Namdeo (1999) reported that application of balance fertilization with 5 tons FYM to soybean increased the protein and oil yield over control. Similarly, Pannercerluan et al., (1998) reported that soybean seed yield, oil and protein content were increased with NPK fertilizer and its value further accelerated when balance fertilizer were dressed with FYM+Rh+PSB application. A positive correlation between seed yield with protein and oil content has been established by Dwivedi and Bapat (1998) who investigated rapid accumulation of protein in crop containing both oil and protein like soybean. Singh *et al.,* (2003) reported oil yield and nutritionally quality of seeds was affected by integrated nutrient management and found that combinations of organic and inorganic, application of 75% NPK+5 tonnes, FYM/ha recorded the highest protein (34.93%), oil yield (17.87%), mineral content (4.93%) in soybean. Sharma (2003) reported that Gypsum at 50 kg/ha gave the highest seed yield (2257 kg/ha), oil (20.51%) and protein contents (41.29%) and net returns.

Oil content

Oil content in soybean seeds was markedly influenced by different doses of fertilizers. Oil content of soybean seed produced under different treatments differed significantly and ranged from 16.20 to 19.47 present. The maximum oil content of 19.47 percent was observed in T8 (100 NPK % + FYM + imazethapyr). Oil content had increased significantly from 16.20 T10 (control + imazethapyr) to 17.57 and 18.54 percent in T2 and T3 (100% NPK and 150% NPK+imazethapyr) treatments, respectively. Oil content in T1, T6 AND T7 (50% NPK 100% NP and 100% N) treatments were almost equal and nearly the same as that obtained with T2 (100%NPK+ imazethapyr) and T8(100%NPK + FYM+ imazethapyr) treatments. However the oil content was statistically found not significant when T3 (150% NPK+ imazethapyr) and

T5 (100% NPK + Zn + imazethapyr) treatments were applied.

The minimum content of protein and oil was associated with imbalance fertilizer 100%N application as well as in control plots where no fertilizer was applied. However, when P was added in fertilizer schedule the protein and oil value was added slightly and it was followed further gradually increasing trend when successive addition of fertilizers was applied from sub optimal, optimal to super optimal doses (Table 1 and 2). Singh et al., (2003) and Hyten et al., (2004) also reported similar findings as in present experiment. However there were drastically reduced in T_7 and T_{10} treatment. Further, the response to K could not be visualized in yield but was quite apparent in its effect on seeds quality. Treatment T_4 (100%NPK+HW) found good in resulting higher protein and oil than T_{10} because less composition between crop and weed.

CONCLUSION

100%NPK+FYM (T_8) treatment resulted not only in increased total dry matter & seeds of soybean, but also improved nutritive values of the grain in terms of nutrients, oil and protein content. The result of the study imply that the use of balance rate of minerals fertilizer in combination with organic manures must form part of soil management practices for the intensively cultivated soil to sustain soil health and batter productivity and crop quality along with use of herbicide for weed control measures.

REFERENCES

Bachhav PR, Sable RN (1996) Effect of different sources of nitrogen on growth parameters, yield and quality of soybean. J. Maharashtra Agric. Univ. 21:244-247.

Chandel AS, Tiwari SK, Sexena SC (1989) Effect of micronutrient application on soybean grown in Uttarpradesh foot hills. Indian J. Agric. Sci. 1:62-63.

Dwivedi AK, Bapat PN (1998) Sulphur Phosphorus interaction on the synthesis of nitrogen fraction and oil in soybeans. Indian Soc. Soil Sci. 46:154-157

Hyten DL, Pantalone VR, Sams CE, Saxton AM, Landau Ellis D, Stefaniak TR, Schmidt ME (2004) Seed quality QTL in a prominent soybean population. Theo. App. Genetics. 10:552-561.

Khajouei Nejad G, Kazem H, Alyari H, Javanshir A, Arvin MJ (2004) Irrigation regimes and plant population density effects on seed yield, protein and oil con tent of three soybean cultivars. Turkish J. Field Crops. 9:62-71.

Loux Mark M, Reese Kirk D (1993) Effect of soil and pH on persistence and carryover of imidazolinone herbicide. Weed Tech. 7:452-458.

Pannecrsluan S, Lourduraj AC (1998) Effect of organic manures, inorganic fertilizers and weed Management practices on the yield attributes and yield of soybean. Legume Res. 21:159-164.

Patil NB, Ingole GL, Raut PD, Dangore ST (2003) Impact of manuring and fertilization on yield, quality and nutrient uptake of soybean. Ann. Plant Physio. 16:166-169.

Renner KA, Schabenberger O, Kells JJ (1998) Effect of tillage and application method on corn (Zea mays) response to imidazolinone residues in soil. Weed Tech. 12:281-285.

Sharma KN, Namdeo KN. (1999) Effect of biofertilisers and phosphorus on NPK contents uptake and grain yield,quality of soybean and nutrient straw of soil. Crop Res. 17:164-169.

Sharma RA, Mishra OR (1997) Crop residue, FYM and fertilizer use in relation to growth yield and nutrient uptake of soybean. Crop Res. 13:51-57.

Sharma RK (2003) Seed yield, quality and economics of soybean (Glycine max (L) Merrill) as influenced by levels and sources of sulphur. Annals Agric. Res. 24:354-357.

Singh AB, Ghosh PK, Ajay (2003) Effect of integrated nutrient-management practices on improvement in grain quality of soybean, sorghum (Sorghum bicolor) and wheat in multiple cropping systems in Vertisol. Indian J. Agric. Sci. 73:65-68

Singh S, Singh RN, Prasad J, Kumar B (2002) Effect of green manuring, FYM and Biofertilizer in relation to fertilizer nitrogen on yield and major nutrient uptake by upland rice. J. Indian Soc. Soil Sci. 50:313-314.

Sondhia S(2005). Phytotoxicity and persistence of metribuzin residues in black soil. Toxicol. Environ. Chem.87: 387-389.

Sondhia S (2008a) Terminal residues of imazethapyr in soybean grains, straw and soil. Pestic. Res. J. 20(1): 128- 129.

Sondhia S(2008b) Determination of imazosulfuron persistence in rice crop and soil. Environ. Monit. Assess.137: 205-211.

Sondhia S(2008c). Phytotoxicity and persistence of metribuzin residues in black soil. Toxicol. Environ. Chem. 87(3): 389-397.

Sondhia S(2007). Persistence of metsulfuron-methyl in wheat crop and soil Environ. Monit. Assess. 147: 463-469.

Sondhia S (2013) Dissipation of pendimethalin in soil and its residues in pea (Pisum sativum L.) under field conditions. J.Environ. Sci. Hlth, Part B 48 (12): 1043-1048.

Stougaard RN, Shea PJ, Martin AR (1990) Effect of soil type and pH on adsorption, mobility, and efficacy of imazaquin and imazethapyr. Weed Sci. 38:67-73.

Gennari M, Negre M, Vindrola D (1998) Adsorption of the herbicides imazapyr, imazethapyr and imazaquin on soils and humic acids. J. Environ. Sci. Health. 33: 547-567.

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