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Effect of various nitrogen management sources on growth and yield of Soybean in Vertisols

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Abstract
A field experiment entitled "Studies on nitrogen source diversification in vertisols and its effect on soybean productivity" was conducted during the year 2017-18 at the Research Farm of Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experiment was laid out in randomized block design with three replications. The treatments were comprised of seven nutrient management practices viz., RDF (30:75:30 NPK kg/ha^{-1}) and in remaining six treatments, 50 % RDN was given through urea and 50 % RDN through different organic sources viz. Vermicompost, FYM + Jivamrut, FYM, Compost, soybean crop residue + *Trichoderma virride* and glyricidia leaf incorporation. It was found that highest values of growth and yield parameters was noticed with treatment RDF alone (35.88 g) being at par with treatment 50%RDN + 50% N through vermicompost.

Keywords: Nitrogen source diversification, Vertisols, Soybean, Yield

Introduction
Soybean (*Glycine max* L.) is one of the important oilseed as well as leguminous crop. Soybean as a miracle "Golden bean" of the 21st century mainly due to its high protein (40%) and oil (20%) content. In India it is mainly grown as 'oilseed crop'. Soybean (*Glycine max* L.) is known as sojabean, soybean, Chinese pea and Manchurian bean which belongs to family Leguminaceae and has Eastern Asian Origin. Soybean was cultivated in China from 3000 BC. It is the miracle crop which has witnessed phenomenal growth in production. Processing and trade of soybean in last few years in India has revolutionized the rural economy and improved socio-economic status of farmers. Soybean cultivation has placed India on the world map in recent past. Soybean has not only gained the vital importance in Indian Agriculture, but also plays a decisive role in oil economy of India.

Soybean has been accredited as principle food crop since long time that produces 2-3 times more high quality protein yield per hectare than other pulses and cholesterol free oil. It is preferred especially by vegetarians on account of its richness in protein, fat, carbohydrates, mineral salts and vitamins.

It is a multipurpose crop used for making soya milk, soya paneer, soya yogurt, soya ice-cream etc. Soya flour, soya fortified foods staffs and biscuits have good acceptability among the people because of economical and nutritional advantages. Moreover, it is widely used in oil production in India out of the total soybean produced; about 85 per cent is utilized for oil extraction, 10 per cent for seed and 5 per cent for food purpose.

However, continuous use of chemical fertilizers is leading in the crop yield stagnation and resulted in imbalance of nutrients in the soil which has adverse effects on soil health. Use of organic manures alone or in combination with chemical fertilizers will help to improve physico-chemical properties of the soils, efficient utilization of applied fertilizers for improving seed yield and seed quality.

Materials and Methods
A field experiment entitled "Studies on nitrogen source diversification in vertisols and its effect on soybean productivity" was conducted during the year 2017-18 at the Research Farm of Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra).

The soil of the experimental plot was very fine, clayey in texture dominated by smectite clay minerals which belongs to hyperthermic family of Typic Haplustert having swell shrink property. It was slightly alkaline in reaction, medium in organic carbon content, low in nitrogen and phosphate content while very high in exchangeable potassium.

The rainfall received during the cropping period amounted 569.2 mm as against the normal of 599.5 mm for the specific duration. However, the crop experienced two dry spells; first during the seedling stage; and second during the pod formation stage, which unfavorably reflected in overall crop growth and development.

The experiment was laid out in randomized block design with four replications. The treatments were comprised of five nutrient management practices *viz*., T1: RDF Alone, T2: 50% RDN + 50 % RDN through Vermicompost, T3: 50 % RDN + 50% RDN through FYM + Jivamrut @500 lit/ha., T4: 50 % RDN + 50 % RDN through FYM, T5: 50% RDN + 50% RDN through Compost, T6: 50 % RDN + 50 % RDN through soybean crop residue + *Trichoderma virrid*e @ 1kg/ha and T7: 50% RDN + 50% RDN through Glyricidia leaf incorporation.

Sowing of soybean was taken on 28th June, 2017 at spacing of 45 x 05 cm2 with two seeds per hill at a depth of 4-5 cm and seed rate of 75 kg ha^{-1}.

Soil pH was determined in soil suspension (1:2.5 soil. water) by a glass electrode pH meter after equilibrating the soil with water for 30 minutes with occasional stirring (Jackson, 1973) [7]. Electrical conductivity was determined in soil suspension (1:2.5 soil water) after equilibrating the soil with water and keeping the sample undisturbed till the supernatant solution is obtained and measured using conductivity meter (Jackson, 1967) [6].

The available nitrogen from soil was estimated by alkaline permanganate method by Subbiah and Asija (1956) [11]. Available phosphorus from soil was estimated by Olsen's method. The available potassium from soil was determined by neutral normal ammonium acetate extrct using Flame Photometer. (Hanway and Haidel, 1952).

Chemical analysis of plant was done after harvest for determining the nutrient uptake (N, P, and K) by plant and seed.

The experimental data collected during the course of investigation were analyzed with Randomized Design Design programmed on computer by adopting standard statistical techniques of analysis of variance (Gomez and Gomez, 1984) [5].

Results and Discussion

Highest number of pods plant-1 (69.53) was noticed with treatment RDF alone. However, the values obtained with this treatment (62.58) were found statistically identical with that of treatment 50% RDN + 50% N through vermicompost. Weight of pods plant-1 was found to be significantly improved with treatments RDF alone (21.25 g) and 50% RDN + 50% N through vermicompost, (19.76 g), both being at par with each other. Application of 100% RDF through chemical fertilizers significantly improved the weight of seeds plant^{-1} (13.02 g) of soybean. Among the replacement of nitrogen through organic treatments, application of 50% RDN + 50% N through vermicompost proved as the best treatment with weight of seeds plant-1 up to 12.20 g. Application of RDN through different sources found to be non-significant on number of seeds per pod and 100 seed weight of soybean crop.

The treatment RDF alone recorded significantly highest seed yield (2102 kg ha^{-1}) of soybean being statistically similar with treatment where 50% of N was added through vermicompost (2057 kg ha-1). Treatment (RDF alone) yielded the straw to an extent of 2660 kg ha-1 and found superior over other treatments.

It was found statistically on par with treatments 50% RDN + 50% N through vermicompost and 50% RDN + 50% N through compost with straw yield of 2610 and 2450 kg ha-1, respectively. Significant improvement in biological yield (4762 kg ha-1) was observed with treatment RDF alone. Among the nitrogen substitution treatments, application of 50% RDN + 50% N through vermicompost was found as the most promising treatment, which recorded 4667 kg ha-1 of biological yield and being at par with RDF. The maximum harvest index of 44.14 was evident with treatment RDF alone. The next best treatment in this regard was that of application of 50% RDN + 50% N through vermicompost with respective value of 44.08. Lowest harvest index of 43.18 was noted with treatment 50% RDN + 50%N thr. Soybean crop residue + *T. virride.*

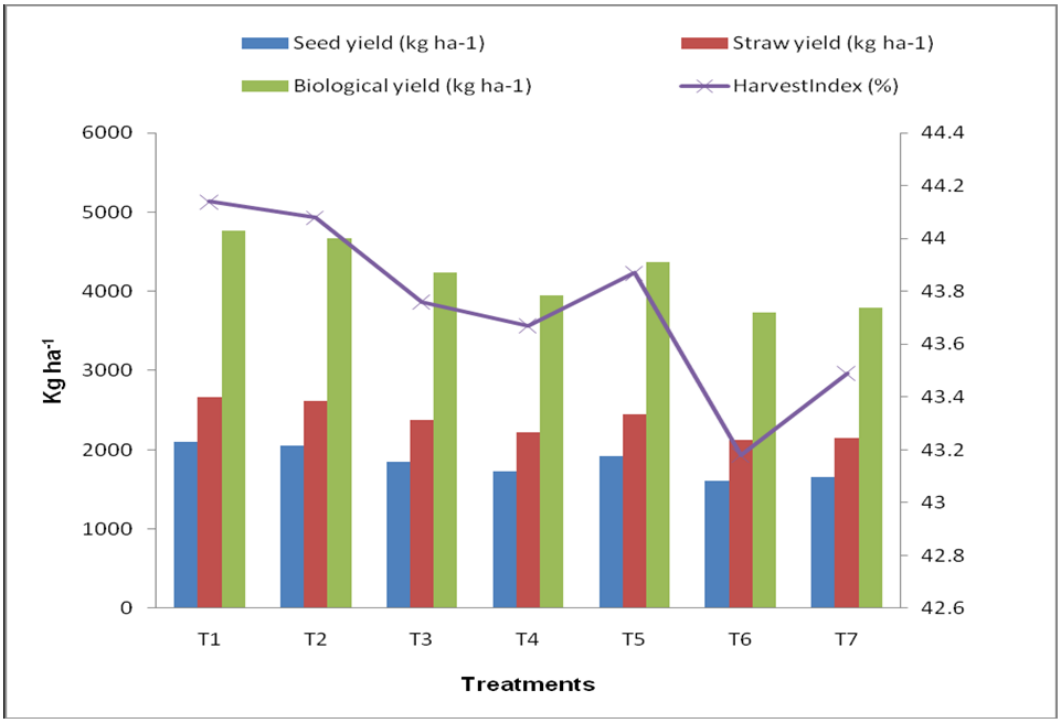

Fig 1: Seed yield (kg ha-1), straw yield (kg ha-1), biological yield (kg ha-1) and harvest index of soybean as influenced by various treatments

Conclusion

1. Soybean growth characters viz., plant height (cm), number of functional leaves plant-1, leaf area (dm2) plant-1, number of branches plant-1 and plant dry matter accumulation (g) plant-1 get significantly improved with application of RDF through chemical fertilizers. However, the INM through treatment of 50% RDN + 50% Nitrogen through vermicompost recorded statistically similar improvement in all these growth characters when compared with application of chemical fertilizers alone.
2. Yield attributes of soybean, grain yield, straw yield, protein yield and oil yield were significantly improved with application of RDF through chemical fertilizers and being statistically comparable with treatment of 50 %RDN + 50 % RDN through Vermicompost.
   Thus, finally, it can be inferred that 50% of nitrogen can safely replace by application of vermicompost, without any reduction in crop yield, quality and economic returns.

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