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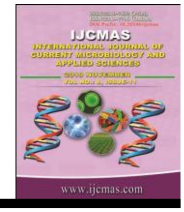

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# Effect of Site Specific Nutrient Management on Yield and Quality of Soybean [*Glycine max* (L.)] in Soybean in Vertisols

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**A B S T R A C T**

The field experiment was conducted to study the effect of omission of N, P and K fertilization and balanced NPK under it specific nutrient management in akola district in Vertisols. N omission with ample PK, omission of P with ample NK, omission of K with ample NP, and Ample NPK. The experiments comprised of four treatments as per the omission plot technique in randomized block design replicated on fifteen farmers' fields and each farmer's field considered as one replication. The treatment wise yield of seed and straw was recorded significantly highest with balanced application of NPK. The seed yield of soybean was most influenced by omission of phosphorus indicating that phosphorus is most crucial element in soybean production. Balanced application of NPK recorded higher protein content, oil content and test weight of soybean.

## Introduction

Soybean is an oilseed as well as pulses crop having excellent nutritional quality, to contributes the highest world oil production. Phosphorus, an important constituent of biochemical products in plant itself; plays a key role in balance nutrition of the soybean and affect its productivity. Balanced fertilization is the key to achieve higher productivity and nutrient use efficiency and balanced nutrition with NPK proved beneficial in all the oilseed crops both under rainfed and irrigated conditions. Further, nutrients like S, Ca, Cu and B are also needed for higher yields (Ghosh *et al.,* 2002). SSNM strategies that include site and specific knowledge of crop nutrient requirement and indigenous nutrient supplies is useful for improving nutrient use efficiency and crop productivity as well as for maintaining soil health in semi arid eco regions. Right fertilizer management must support stake holder's to contribute goals of performance. The farmers are best managers of their land and their final decision makes in selecting the practices suited to local site specific soil, water and crop production conditions and local regulation that have the highest profitability of meeting the goals (Majumdar *et al.,* 2013).

Site-specific nutrient management (SSNM) is a plant-based approach, which enables farmers to optimally supply their crop with essential nutrients. The optimal supply of nutrients for crop can vary from field-to-field depending on crop and soil management, historical use of fertilizers, management of crop residues and organic materials, and crop cultivar.

Hence, the SSNM approach provides the principles and guidelines for tailoring nutrient management practices to specific field conditions Optimally supplying crops with essential nutrients as and when needed to achieve high yield and high efficiency of input use involves three steps. The first step is to establish an attainable yield target, which is location and season-specific depending upon climate and crop management. This yield target or goal reflects the total amount of nutrients that must be taken up by the crop.

The second step is to ensure effective use of existing indigenous nutrients such as from soil, organic amendments, crop residue, manure, and irrigation water.

The third step is to apply fertilizer to dynamically fill the deficit between crop needs and indigenous supply and to maintain soil fertility. The judicious and balanced fertilizer use is useful for sustaining agricultural crop productivity as well as maintaining soil quality. The varied response of the intensively grown crop like soybean grown in Vertisols to the applied nutrients reveal the potential of soil, effectiveness of nutrients added and the indigenous nutrient supplying capacity of soil looking to this, present study was carried out.

## Materials and Methods

The field investigation was carried out to study the response of site specific nutrient management on yield and quality of soybean during the *kharif* season 2014-15 and 2015-16 at farmers' fields in village's in Akola district. The experiment was laid out in Randomized Block Design (RBD) with fifteen replication. One farmer's field was considered as one replication. The experiment consist of four treatments viz., $T_{1:}$ N omission with PK, $T_2$: P with NK, $T_3$ : K omission with NP, $T_4$: ample NPK. The omission plot technique was used in the present study where in each major nutrient nitrogen, phosphorus and potassium was omitted and the ample NPK was applied in one treatment ($T_4$) in order to study the response of the crop under this varied nutrient rates. The rate of ample nutrients was applied for soybean as 30:100:80 N, $P_2O_5$ and $K_2O$ kg ha$^{-1}$. The complete dose of NP was applied as basal as per treatments while K was applied in to splits (40:40) at sowing and at flowering. The soil of experimental site was deep and very dark black in colour at each sites and grouped as Vertisols. The initial composit soil samples from each site were collected, processed and analyzed for initial soil fertility status. The weight of 100 seeds of soybean from each net plot was recorded. The crude protein was computed by multiplying the nitrogen content with 6.25 and oil content was estimated by Soxhlet extract in method as described by Jackson (1973).

## Results and Discussion

### Seed and straw yield of soybean

Growth and biomass production were strongly influenced by indigenous nutrient supply and the nutrients supplied through fertilizers. This was reflected in yield parameters, seed and straw soybean yield (Table 1 and Figure 1). The seed yield of soybean during 2014-15 ranged from 14.41 to 18.61 q $ha^{-1}$ and during second year of study varied to from 16.61 and 19.92 q $ha^{-1}$ while mean seed cotton yield varied from 15.51 to 19.26 q $ha^{-1}$. The seed yield of soybean influenced significantly during both the years. The significantly highest seed yield (19.26 q $ha^{-1}$) was recorded with application of NPK followed by omission of K and N while lowest seed yield (15.51 q $ha^{-1}$) was recorded under omission of phosphorus. Thus indicates the importance of phosphorus in soybean crop and its sensitivity to phosphorus. The seed yield was decrease due to omission phosphorus, omission of nitrogen and omission of potassium over combined application of NPK to the magnitude of 19.47, 16.56 and 8.26 per cent respectively. The higher seed yield with the combined application of NPK could be attributed to adequate supply of nutrients through balanced nutrient management system which helped for proper growth and yield attributes and led higher grain yield. Kolo *et al.*,(2012) also reported similar findings. Katkar *et al.*, (2012) recorded that that application of NPK recorded significantly highest yield of soybean.

The straw yield of soybean at harvest stage varied from 20.99 to 26.14, 24.44 to 26.77 and 22.72 to 26.45 q $ha^{-1}$ in 2014-15, 2015-16 and pooled mean of two years respectively. The pooled mean of straw yield recorded was significantly highest (26.45 q $ha^{-1}$) under combined application of NPK whereas lowest straw yield (22.72 q $ha^{-1}$) was registered in treatment omission of nitrogen. The reduction in straw yield was strongly related to the N supply, omission of which resulted in 14.10 per cent reduction. The reduction in the straw yield was 12.74 and 6.24 % due to P and K omission, respectively. The highest straw yield in balanced NPK might be ascribed due to enhanced nutrient uptake and efficiency of nutrients. The results are in line with the findings reported by Singh *et al.*, (2001). Thus, it could be observed that, the soil has the capacity to supply nutrients indigenously to some extent. The native nutrients in soil can provide nutrients to sustain the crop yield for some year, this has been indicated by omission of N, P and K. The supply of ample quantity of NPK externally through fertilizers increased the seed and straw yield of soybean significantly.

## Seed quality parameter

The oil content varied from 19.17 to 19.79, 18.87 to 19.90 and 19.07 to 19.85 per cent in first year, second year and pooled mean of two years respectively. It was noticed that the oil content were proportionate from 19.55 to 19.98 in treatment ample quantity of NPK over omission treatments. The significantly highest oil content (19.85) were observed with application of NPK in ample quantity ($T_4$) which were significantly superior over rest of the treatments. The lowest oil content (19.07) was recorded in treatment of omission of phosphorus. The omission of nitrogen, phosphorus and potassium showed 1.56, 3.93 and 1.26 per cent reduction in oil content in seed. In nutshell, it could be noticed that, the higher reduction in oil content during both years study was noticed due to omission of phosphorus from the fertilizer application. Similar finding were reported by Mohapatra *et al.*, (2013), Vladimir *et al.*, (2010).

The protein content in seed of soybean varied from 36.57 to 39.10, 35.37 to 37.97 and 35.95 to 38.54 per cent during 2014-15,2015-16 and pooled mean of two years respectively. The protein content of soybean was noticed to be improved significantly (38.54 %) due to the application NPK as compared to N, P and K omission. The two year mean percentage reduction in protein content due to omission of N ($T_1$), omission of P ($T_2$) and omission of K ($T_3$) over conjoint application of NPK was decreased (Table 2).

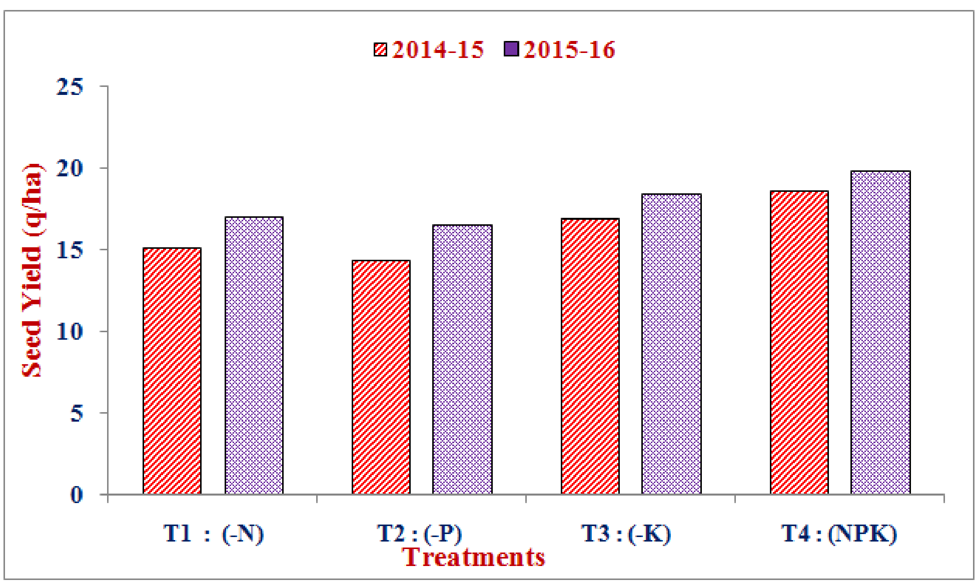
**Table.1** Effect of nutrient management on seed and straw yield of soybean

| Treatment | Seed yield (q ha$^{-1}$) | | | Straw yield (q ha$^{-1}$) | | |
|---|---|---|---|---|---|---|
| | 2014-15 | 2015-16 | Mean | 2014-15 | 2015-16 | Mean |
| $T_1$ : (-N) and PK | 15.10 | 17.02 | 16.07 | 20.99 | 24.44 | 22.72 |
| $T_2$ : (-P) and NK | 14.41 | 16.61 | 15.51 | 21.69 | 24.47 | 23.08 |
| $T_3$ : (-K) and NP | 16.91 | 18.44 | 17.67 | 23.79 | 25.81 | 24.80 |
| $T_4$ : (NPK) | 18.61 | 19.92 | 19.26 | 26.14 | 26.77 | 26.45 |
| SE (m)± | 0.31 | 0.27 | 0.20 | 0.51 | 0.28 | 0.31 |
| CD at 5 % | 0.88 | 0.77 | 0.58 | 1.46 | 0.81 | 0.91 |

**Table.2** Effect of nutrient management on quality parameter of soybean

| Treatment | Quality parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Oil content (%) | | | Protein content (%) | | | Test weight (g/ 100 seed) | | |
| | 2014-15 | 2015-16 | Mean | 2014-15 | 2015-16 | Mean | 2014-15 | 2015-16 | Mean |
| $T_1$ : (-N) and PK | 19.44 | 19.63 | 19.54 | 36.57 | 35.33 | 35.95 | 12.39 | 12.12 | 12.26 |
| $T_2$ : (-P) and NK | 19.17 | 18.97 | 19.07 | 38.37 | 36.28 | 37.32 | 11.96 | 11.74 | 11.85 |
| $T_3$ : (-K) and NP | 19.53 | 19.67 | 19.60 | 38.38 | 37.38 | 37.88 | 12.67 | 12.50 | 12.58 |
| $T_4$ : (NPK) | 19.79 | 19.90 | 19.85 | 39.10 | 37.97 | 38.54 | 13.18 | 13.11 | 13.15 |
| SE (m)± | 0.050 | 0.082 | 0.05 | 0.13 | 0.29 | 0.15 | 0.09 | 0.13 | 4.48 |
| CD at 5 % | 0.145 | 0.233 | 0.15 | 0.384 | 0.82 | 0.44 | 0.27 | 0.39 | 12.78 |

**Fig.1** Effect of nutrient management on seed yield of soybean




The lower protein in omission treatment could be ascribed to that nitrogen is an essential element required for synthesis of protein and absences of N from fertilizer application reduced the protein content during both the study years. The finding corroborates with the results reported by Alexander *et al.,* (2010) and Bairagi *et al.,* (2007).

The increase in protein percent in seeds might be due to the high accumulation of nitrogen in seeds. Application of nitrogenous fertilizers is known to improve the protein content in soybean seed. The present findings are supported with the results obtained Yadav *et al.,* (2010) Since N is an important constituent of amino acids, proteins and protoplast, its application had a more pronounced effect on plant growth and development through better utilization of photo-synthesis and more vegetative growth. These results are in conformity of the findings of Singh, (2008) and Sharma *et al.,* (2000).

The test weight of soybean seed at harvest stage varied from 11.96 to 13.18, 11.74 to 13.11 and 11.85 to 13.15 g during first year, second year and pooled mean of 2 years respectively. The mean of test weight was (13.15 g) found to be highest with the ample application of NPK.

The test weight of soybean seed in NPK omission treatments indicated that the nutrients are required in balanced quantity. In soybean, phosphorus is most influencing nutrient as indicated by highest reduction in test weight (9.89 %) as compared to application of NPK in ample quantity. Nath *et al.,* (2012) reported similar results with the application of NPK.

Thus, it can be concluded that the site specific nutrient management with balanced application of nutrients to soybean enhanced the seed yield and their quality.

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