Original Research Article

Studies on Farm Crop Response to Plant Nutrients in Predominant Cropping Systems and their Impact on Crop – Livestock – Human Continuum under Central Vidharbha Zone of Maharashtra

Y. D. Charjan¹*, R. S. Wankhade² and M. R. Deshmukh³

¹Experiments on Cultivators Field (OFR), Katol, Dist. Nagpur, India
²Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, India
³Agriculture Research Station, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Achalpur Dist. Amravati- Maharashtra, India

*Corresponding author

A B S T R A C T

A experiment was carried out on twenty four farmer’s fields to study the response of major nutrients NPKS on soybean-wheat, soybean-chickpea and cotton-fallow crops sequences in Central Vidarbha Zone (Nagpur) Maharashtra during the year 2018-19. A set of eight treatments comprises of no NPK, 100 % N, 100 % N + 100 % P, 100 % N + 100 % K, 100 % N + 100 % P + 100 % K, 100 % N + 100 % P + 100 % K + 100 % Sulphur, use of organic manure / bio-fertilizers and farmers practice after categorization in initial similar factors by R statistical method analysis. Result indicated that application of recommended NPK + Sulphur recorded significantly higher yields in soybean (1302 kg ha⁻¹)– wheat (2042.69 kg ha⁻¹), soybean (1464.03 kg ha⁻¹)– chickpea (1654.99 kg ha⁻¹) and cotton (1889.35 kg ha⁻¹) crop, respectively. Similarly, the total increase in monitory returns by 10, 13 and 10 percent and net returns of Rs. 88645 ha⁻¹, 116358 ha⁻¹ and 100135 ha⁻¹ under soybean–wheat, soybean – chickpea and cotton – fallow sequential cropping system, respectively.

Keywords: On-farm experiment, Economics, Cropping systems, Central Vidarbha Zone

Introduction

The Central Vidarbha Zone comprises of Yavatmal, Nagpur, Wardha, and part of Chandrapur districts. The Central Vidarbha Zone is the VIIth Agro Climatic zone of Maharashtra State having assured rainfall zone. This tract has hot summer, moderate winter and rainy season which receive 950 to 1250 mm rainfall in 60 to 70 rainy days. Soils are derived from basalt rock, black in color and having varying in depth. Vertisols, Inceptisols and Entisols are the dominant soil orders occurring in the zone. Soil type in these districts having deep black (43.4 %), medium deep black (13.8 %) and shallow soils (42.7 %) having with an area of 427.9, 136.4 and 421.5 (area 000 ha) hectare, respectively. Main agronomical crops of this zone are cotton, soybean, sorghum, pigeon
pea in *kharif* and wheat and gram in *rabi* season. Nagpur mandarin and vegetable crops viz., brinjal, tomato grown in Nagpur district.

During 2018-19 the experiments were conducted in two blocks of Nagpur district. One is high productive block of Katol and second low productive block of Narkhed. Major farming system of the district is crop + livestock. Soybean-wheat, Soybean-Chickpea and Cotton-fallow cropping system, a lifeline for the majority of the population in Central Vidarbha Zone is under stress, due to the imbalanced and indiscriminate use of fertilizers.

Therefore, we conducted an on-farm study at two locations (Katol and Narkhed in Nagpur District) covering Twenty Four Farmers to judge the response of NPK and S in Central Vidarbha Zone (Nagpur) Maharashtra.

**Materials and Methods**

Data employed in this study were taken from on-farm experiments conducted with Soybean and wheat, Soybean and Chickpea and Cotton-Fallow between 2018 to 2019 in the Indian districts of Nagpur in the Maharashtra state, under the umbrella of the All India Coordinated Research Project (AICRP) on Integrated Farming systems (IFS) by the Indian Council of Agricultural Research (ICAR). A experiment was carried out on farmers field to study the response of major nutrients NPKS on soybean-wheat (06 farmers), soybean-chickpea (06 farmers) and cotton-fallow (12 farmers) in crops sequences on twenty four farmer’s fields in Central Vidarbha Zone (Nagpur) Maharashtra during the year 2018-19. Treatments comprises viz.,

- **T<sub>1</sub>** – No NPK,
- **T<sub>2</sub>** – 100 % N,
- **T<sub>3</sub>** – 100 % N + 100 % P,
- **T<sub>4</sub>** – 100 % N + 100 % K,
- **T<sub>5</sub>** – 100 % N + 100 % P + 100 % K,
- **T<sub>6</sub>** – 100 % N + 100 % P + 100 % K + 100 % Sulphur,
- **T<sub>7</sub>** – Use of organic manure / Bio-fertilizers and **T<sub>8</sub>** – Farmers practice, respectively with six replications in Soybean – Wheat, six in Soybean – Chickpea and twelve in Cotton – fallow sequence cropping systems after categorization in initial similar factors by R statistical method analysis. Similar farmer taken into the cluster for study. Information of farmers collected and identical farmers were chosen. The levels of applied nutrients were used as per the standard recommendation of the University.

During *Kharif* 2018, Nagpur district received total 902.6 mm rainfall in 55 rainy days, 20.79 % less with reduced number of rainy days than normal. The total rainfall received and number of rainy days in operational block i.e. Narkhed 571.4 mm in 36 rainy days and in Katol block 581.7 mm in 40 rainy days which was 44% and 40% less than normal, respectively. During the crop growth stages particularly at the time of flowering to pod development stage of soybean crop, it was affected due to less rainfall. Also early withdrawal of mansoon resulted into low yield of long duration crop like cotton and pigeon pea.

The meager infestation of whitefly and *spodoptera* recorded on soybean crop which was controlled by spraying of recommended insecticides during the crop growing period. This year, some pockets of cotton were infested by boll worms which resulted into low seed cotton yield.
Results and Discussion

Soybean – wheat system

The yield benefit due to treatments is given in Table-1 and in Figure 1. The data indicated that the yields of soybean were increased significantly due to application of all treatments over control and Soybean yield 1302 kg ha\(^{-1}\) was obtained by application of recommended dose of NPK + Sulphur which was significantly superior over application of all treatments. The highest net return under Soybean - Wheat system was recorded Rs 88645 ha\(^{-1}\) due to application of NPK with Sulphur and lowest Rs 34887 ha\(^{-1}\) with control treatment. Similar observations were reported by Bhattacharyya et al., (2008).

Table 1 Influence of treatments on grain yield (kg/ha), economics (Rs/ha) and nutrient response (kg/kg & Rs/re) of crops for soybean – wheat cropping system

| Treatments | Kharif (Soybean) Kg/ha | Rabi (Wheat) Kg/ha | SEY Kg/ha | SYS cost of cultivation | System net returns |
|------------|------------------------|--------------------|-----------|-------------------------|-------------------|
|            | Grain                  | Grain              | Grain     | Rs/ha                   | Rs/ha             |
| Control    | 445.57                 | 896.93             | 1090.24   | 31025                   | 34887             |
| N          | 596.03                 | 1070.53            | 1365.47   | 32634                   | 43695             |
| NP         | 891.15                 | 1498.75            | 1968.37   | 34218                   | 62987             |
| NK         | 769.63                 | 1232.56            | 1655.53   | 33113                   | 52976             |
| NPK        | 1139.97                | 1637.63            | 2137.02   | 36344                   | 74144             |
| NPK + S    | 1302.00                | 2042.69            | 2770.19   | 38869                   | 88645             |
| Organic    | 758.05                 | 1267.28            | 1668.91   | 33835                   | 53405             |
| FP         | 688.61                 | 1001.09            | 1408.15   | 29547                   | 45060             |
| CD (P=0.05)| 111.93                 | 187.11             | 192.13    | -                       | -                 |
| CV (%)     | 11.64                  | 12.05              | 9.25      | -                       | -                 |

Table 2 Influence of treatments on grain yield (kg/ha), economics (Rs/ha) & nutrient response (kg/kg & Rs/re) of crops for soybean- chickpea system

| Treatments | Kharif (Soybean) Kg/ha | Rabi (Chickpea) Kg/ha | SEY Kg/ha | SYS cost of cultivation | System net returns |
|------------|------------------------|-----------------------|-----------|-------------------------|-------------------|
|            | Grain                  | Grain                 | Grain     | Rs/ha                   | Rs/ha             |
| Control    | 567.09                 | 694.40                | 1478.49   | 28920                   | 47311             |
| N          | 729.12                 | 908.51                | 1921.54   | 30290                   | 61489             |
| NP         | 1111.04                | 1249.92               | 2751.56   | 31958                   | 88049             |
| NK         | 1111.04                | 1058.96               | 2500.93   | 32519                   | 80029             |
| NPK        | 1232.56                | 1406.16               | 3078.15   | 34616                   | 98500             |
| NPK + S    | 1464.03                | 1654.99               | 3636.20   | 36360                   | 116358            |
| Organic    | 908.51                 | 1151.55               | 2419.91   | 30538                   | 77437             |
| FP         | 792.77                 | 810.13                | 1856.07   | 28374                   | 59394             |
| CD (P=0.05)| 153.03                 | 180.62                | 305.26    | -                       | -                 |
| CV (%)     | 11.64                  | 12.05                 | 9.25      | -                       | -                 |
Table 3 Influence of treatments on seed cotton yield (kg/ha), economics (Rs/ha) & nutrient response (kg/kg & Rs/re) of crops for cotton-fallow system

| Treatments | Kharif (Cotton) Kg/ha | Rabi (Fall.) Kg/ha | SEY Kg/ha | SYS cost of cultivation | System net returns |
|------------|-----------------------|--------------------|-----------|-------------------------|--------------------|
|            | Seed cotton           | Grain              | Grain     | Rs/ha                   | Rs/ha              |
| Control    | 717.55                | -                  | -         | 19162                   | 38029              |
| N          | 917.15                | -                  | -         | 20175                   | 48610              |
| NP         | 1571.08               | -                  | -         | 22171                   | 83267              |
| NK         | 1336.72               | -                  | -         | 19572                   | 70846              |
| NPK        | 1744.68               | -                  | -         | 25034                   | 92468              |
| NPK + S    | 1889.35               | -                  | -         | 26338                   | 100135             |
| Organic    | 1102.36               | -                  | -         | 20542                   | 58425              |
| FP         | 928.76                | -                  | -         | 18702                   | 49224              |
| CD (P=0.05)| 156.54                | -                  | -         | -                       | -                  |
| CV (%)     | 5.26                  | -                  | -         | -                       | -                  |

Fig. 1

Fig. 2
Soybean-chickpea system

The yields obtain due to the different treatments is given in Table 2 and Figure 2. The data indicated that the yield of Soybean was increased significantly due to application of N, NP, NK over control. Application of recommended dose of NPK + Sulphur increased the yields i.e. 1464.03 kg ha⁻¹ significantly superior over all treatments. The yields of Chickpea were influenced significantly due to all treatments over control. Application of NPK with Sulphur yielded (1654.99 kg ha⁻¹) significantly superior over all other treatments in chickpea. Highest System yield in soybean – chick pea system was noticed by application of NPK +S i.e. 3636.20 kg ha⁻¹ and more net returns 116358 Rs. /ha were achieved by application of NPK +S over farmers practice. Findings in lines with Singh et al., (2008).

Cotton-fallow system

The yields obtain due to the different treatments is given in Table 3 and Figure 3. The data indicated that the yield of cotton was increased significantly due to application of N, NP, NK over control. Application of recommended dose of NPK + Sulphur increased the yields i.e. 1889.35 kg ha⁻¹ significantly superior over application of N, NP and NK However it was at par with application of NPK. Highest System net returns 100135 Rs. /ha was achieved by application of NPK +S over farmers practice. Similar results were recorded by Srinivasulu and Hema (2007).

In conclusion the result indicated that application of recommended NPK + Sulphur recorded significantly higher yields in soybean (1302 kg ha⁻¹)– wheat (2042.69 kg ha⁻¹ ), soybean (1464.03 kg ha⁻¹) – chickpea (1654.99 kg ha⁻¹) and cotton (1889.35 kg ha⁻¹) crop, respectively. Similarly, the total increase in monitory returns by 10, 13 and 10 percent and net returns of Rs. 88645 ha⁻¹, 116358 ha⁻¹ and 100135 ha⁻¹ under soybean–wheat, soybean – chickpea and cotton – fallow sequential cropping system, respectively.

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Fig.3

_Soybean-chickpea system_

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