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# "RESPONSE OF FARMER BASED CROPPING SYSTEMS TO DIFFERENT SOWING REGIMES"

*R. P. Andhale, B. G. Rathod, A. D. Tambe, A. B. Dhage, B. S. Raskar, V. S. Patil, S. R. Patil and M. B. Dhonde*

*AICRP on Integrated Farming System, Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra)*

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**Abstract**: *Thestudy on "response of farmer based cropping systems to different sowing regimes" was carried out during 2012-13 to 2014-15for three successive years at the All India Coordinated Research Project on Integrated Farming Systems Research Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, District Ahmednagar, Maharashtra (India). The experiment was laid out in split plotdesign with three replications. The treatments comprised of three sowing dates in main plot viz., $24^{th}$ MW (11-17 June), $25^{th}$ MW(18-24 June), $26^{th}$ MW(25 June-01 July) and two crop sequencesviz., Soybean - Wheat and Soybean - Chickpea along with three fertilizer levels for Rabi crop viz.,50 % RDF, 75 % RDF and 100 % RDFas sub plot treatments. The results revealed that, soybean grain equivalent yield was significantly the highest in $24^{th}$ MW (5580 kg $ha^{-1}$) as compared to the late sowing. Soybean- chickpea crop sequence recorded significantly the highest soybean grain equivalent yield (5387 kg $ha^{-1}$), whereas 100% RDFaugmented significantly higher soybean grain equivalent yield (5367 kg $ha^{-1}$) but it was at par with 75% RDF (5174 kg $ha^{-1}$). The soybean –chickpea sequence gave significantly higher gross (Rs. 176616) and net returns (Rs.128451) with B:C ratio (3.69) than that of the soybean- wheat sequence. Hence, it is concluded that, sowing of soybean in $24^{th}$ MW (11-17 June) in Inceptisol followed by sowing of chickpea with 75% recommended dose of fertilizer is suitable for achieving higher productivity and monetary returns from soybean-chickpea sequence.*

**Key words**: *Climate change, Crop sequence, Fertilizer levelsand, Sowing date.*

## Introduction

Soybean is the major rainy season crop in the rainfed agro-ecosystem of central and peninsular India. The crop is predominantly grown on vertisols and associated soils with an average crop season rainfall of about 900 mm. Soybean occupies third place in the oilseed production in India, after groundnut (*Arachishypogaea*) and rape seed (*Brassica napus*)/mustard (*Brassica juncea*). Introduction of soybean in these areas has led to a shift in the cropping system from rainy season fallow followed by post rainy season wheat or chickpea (fallow-wheat/chickpea), to soybean followed by wheat or chickpea (soybean–wheat/chickpea). Global production of Soybean has grown at a CAGR of 2.78% from 215.69 million metric tons in 2004-05 to 283.79 million metric tons in 2013-14.While on one hand production of Soybean in India has increased at a CAGR of 9.60 per cent from 6.87 million tonnes in 2004-05 to 15.68 million tonnes in 2012-13. On the other hand, Soybean meal consumption has also increased at a CAGR of 10.82 per cent over the last eleven years from 1365 thousand million tonnes in 2004-05 to 4225 thousand million tonnes in 2014-15 (Anonymous, 2016). Therefore to keep pace with the increasing demand, it is imperative to increase the productivity level of Soybean in the country.

Soybean crop sown at different meteorological weeks ameliorates the micro climate to the reasonable extend. Among different agronomic practices, proper time of sowing is a most crucial factor and it is a non-cash input, about which the information is to be find out for obtaining maximum yield. Among the various factors responsible for low productivity of soybean improper sowing date is major one. Soybean [*Glycine max (L.)*Merill] based cropping systems are important for sustaining agricultural production and also maintain soil fertility with an ecological balance. Sustainability aims at balanced use of all available resources to achieve maximum production with minimum exploitation of natural resources. Dasog*et al.,* (2011) reported that the success of any cropping system depends upon the appropriate management of resources including balanced use of manures and fertilizers. Cropping systems with suitable grain, legume fodder, oilseed and vegetable and other high value and remunerating crops in proper sequence give high crop productivity and economic returns. A proper sequence of cropping with fertility improvement and exhaustive crops and shallow and deep rooted crops help to maintain the soil fertility and productivity at high level. Chickpea (*Cicer arietinum*) is the second most widely grown legume crop after soybean, accounting for a substantial proportion of human dietary nitrogen intake and playing a crucial role in food security in developed countries. The present study mainly aims at finding the impact of soybean based cropping systems in relation to climate change and identify suitable fertilizer level to different crop sequence.

**Materials and methods**

A field experiment was conducted during *Kharif* and *Rabi* seasons for three consecutive years during 2012-13, 2013-14 and 2014-15 at All India Coordinated Research Project on Integrated Farming Systems Research Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, Maharashtra State, India. The site of experiment is situated at 19$^o$22' N latitude, 74$^o$38' E longitude and an altitude of 540 m above M.S.L. Soil of the experimental plot belongs to the order inceptisol with alkaline pH 8.5, EC 0.31 dsm$^{-1}$ and medium in organic carbon (0.56 %). The available N (216 kg ha$^{-1}$) and available $P_2O_5$ (16.00 kg ha$^{-1}$) were medium and the available $K_2O$ (569 kg ha$^{-1}$) was very high. The experiment comprisedof two cropping systems *viz.,* soybean-wheat and soybean-chickpea in split plot design with three replications and three sowing dates week i.e. 24$^{th}$ MW (11-17 June), 25$^{th}$ MW(18-24 June), 26 $^{th}$ MW(25 June-01 July) as main treatments, three fertilizer levels *i.e.* 50 % RDF, 75 % RDF and 100 % RDF as sub plot treatments were given in *rabi* crops. The net plot size was 4.2 m x 3.6 m. Same plots were used for the same cropping system and management practice in each of the three years. In *kharif*, soybean was grown followed by wheat and chickpea in *rabi* season. Seeds of soybean cv. JS 335 were sown manually in rows 45 cm apart with 10 cm between plants. Crop was manually harvested at physiological maturity stage in the second week of October. After harvesting, the soybean, plots were harrowed twice to facilitate easy in sowing of the *Rabi*crops *viz.*, wheat (*cv.Trimbak*) and Chickpea (*cv.* Vishal)which were manually sown at the rate of 100 kg ha$^{-1}$ for each crop. Economic yields of the component crops were converted to soybean-equivalent yield (SEY), by considering prevailing market prices of the crops. System productivity was calculated by adding the SEY of the component crops.

$$\text{Soybean equivalent yield (Kg ha}^{-1}\text{)} = \frac{\text{Yield of } rabi \text{ crop X Market price of } rabi \text{ crop}}{\text{Market price of soybean}}$$

**Results and discussion**

**Effect of sowing dates on soybean equivalentyield:** The soybean equivalent yield of was significantly affected by different sowing dates. However, soybean equivalentyield was significantly the highest in 24$^{th}$ MW (5580 kgha$^{-1}$) followed by 25$^{th}$ MW (5177 kg ha$^{-1}$) and 26$^{th}$MW (4759 kg ha$^{-1}$); respectively. The economic studies revealed that the early sowing in 24$^{th}$ MW realized numerically higher net monetary returns (Rs. 126172 ha$^{-1}$) and B:C ratio of 3.63 in pooled means. The sowing time is crucial factor that determines the crop yield and has a unique importance in maximum utilization of natural resources like sunlight, available soil moisture and nutrients. The growth phases coincide with environmental conditions in order to produce higher crop yield. Similar observations results were reported by Halwankar *et al.,* (1989).

**Effect of cropping system on soybean equivalent yield**

Soybean equivalent yield in soybean-chickpea (5387 kg $ha^{-1}$) cropping system was significantly higher than soybean- wheat (4958 kg $ha^{-1}$) cropping system. Increase in yield might be due to increase in biological nitrogen fixation and solubilization of more amount of P by phosphate solubilizing bacteria and addition of organic manure (FYM) which might have improved soilphysico-chemical and biological conditions which might be favorable for availability of nutrients to crop throughout the growth period. The economics studies of the cropping sequence revealed that, the highest net monetary returns (Rs.128451 $ha^{-1}$) and B:C of 3.69 ratio was observed in soybean - chickpea cropping system. The results are in confirmation with those reported by Raskarand Bhoi, 2000.

**Effect of cropping system and fertilizers levels on soybean equivalent yield**

Soybean equivalent yield for 100% recommended dose of fertilizer (5367 kg $ha^{-1}$) was significantly higher over the other two fertilizer levels, however it was at par with treatment 75% recommended dose of fertilizer (5174 kg $ha^{-1}$). The treatment 50% recommended dose observed significantly lowest soybean equivalent yield (4976 kg $ha^{-1}$) as compared to 100% and 75% recommended dose of fertilizer, respectively. Similarly the highest net monetary returns (Rs. 92645 $ha^{-1}$) and B:C of 3.15 ratio was with the application of 100 % RDF. The results are in conformity with Nemade*et al*, 2007.

**Conclusion:**

On the basis of the observation and results of three years of experimentation, the soybean-chickpea cropping sequence was found to be most productive and profitable over soybean – wheat crop sequence under normal sowing time of 24th MW along with application of 75 %RDF in *rabi* crop.

**Table 1: Soybean grain equivalent yield of different cropping sequences as influenced by different treatments**

| Treatment | SEY (kg $ha^{-1}$) | | | |
|---|---|---|---|---|
| | 2012-13 | 2013-14 | 2014-15 | Mean |
| **Meteorological Week-3** | | | | |
| 1. MW – 24 (11-17 June) | 5279 | 5455 | 6007 | 5580 |
| 2. MW – 25 (18-24 June) | 4919 | 5045 | 5567 | 5177 |
| 3. MW -26 (25 June- 1 July) | 4240 | 4781 | 5258 | 4759 |
| SE± | 47.90 | 61.18 | 50.88 | 53.62 |
| CD (0.05) | 188.08 | 240.21 | 199.79 | 165.23 |
| **Crop sequence (2)** | | | | |
| 1. Soybean – Wheat | 4658 | 4852 | 5363 | 4958 |
| 2. Soybean – Chickpea | 4967 | 5335 | 5858 | 5387 |
| SE± | 36.99 | 43.10 | 43.74 | 41.39 |
| CD (0.05) | 128.00 | 149.15 | 151.37 | 122.98 |
| **Levels of fertilizer to rabi crop (3)** | | | | |
| 50 % RDF | 4615 | 4907 | 5404 | 4976 |
| 75 % RDF | 4814 | 5093 | 5616 | 5174 |
| 100 % RDF | 5009 | 5280 | 5812 | 5367 |
| SE± | 76.85 | 71.95 | 79.96 | 76.33 |
| CD (0.05) | 224.31 | 210.02 | 233.38 | 215.18 |
| Mean | 4813 | 5093 | 5611 | 5172 |

**Table 2: Economics of different crop sequences as affected by various treatments**

| Treatment | GMR Rs $ha^{-1}$ | Cost of Production Rs $ha^{-1}$ | NMR Rs $ha^{-1}$ | B:C Ratio |
|---|---|---|---|---|
| **Meteorological Week-3** | | | | |
| 1. MW - 24 (11-17 June) | 175458 | 48328 | 126172 | 3.63 |
| 2. MW - 25 (18-24 June) | 164732 | 48328 | 115887 | 3.42 |
| 3. MW -26 (25 June- 1 July) | 157109 | 48328 | 108781 | 3.26 |
| **Crop sequence (2)** | | | | |
| 1. Soybean – Wheat | 154917 | 50358 | 104559 | 3.09 |
| 2. Soybean – Chickpea | 176616 | 48166 | 128451 | 3.69 |
| **Levels of fertilizer to rabi crop (3)** | | | | |
| 50 % RDF | 125976 | 42197 | 83778 | 2.99 |
| 75 % RDF | 132084 | 42598 | 89486 | 3.10 |
| 100 % RDF | 135829 | 43184 | 92645 | 3.15 |

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