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Sachin Sakalle
Faculty of Agriculture,
Rabindranath Tagore
University, Bhopal, Madhya
Pradesh, India

Dig Vijay Dubey
Faculty of Agriculture,
Rabindranath Tagore
University, Bhopal, Madhya
Pradesh, India

Ashook Kumar Verma
Faculty of Agriculture,
Rabindranath Tagore
University, Bhopal, Madhya
Pradesh, India

Rishikesh Mandloi
Faculty of Agriculture,
Rabindranath Tagore
University, Bhopal, Madhya
Pradesh, India

Corresponding Author:
Rishikesh Mandloi
Faculty of Agriculture,
Rabindranath Tagore
University, Bhopal, Madhya
Pradesh, India

Impact of cropping system on growth & yield of Soybean (*Glycine max*)

Sachin Sakalle, Dig Vijay Dubey, Ashook Kumar Verma and Rishikesh Mandloi

Abstract

The agricultural research complex at Rabindranath Tagore University, Mendua, Raisen, hosted the field study named "Diversification of Soybean based cropping systems in Vindhyan plateau region of Madhya Pradesh" during the *Kharif* and *Rabi* seasons of 2020–21 and 2021–22. The study included 8 different cropping sequence treatments, which were combinations of Soybean in the *Kharif* season with Wheat, Chickpea, Mustard, and Garlic in *Rabi*. During the years 2020–2021 and 2021–2022, the trial was conducted using a completely randomised block design with three replications. The two years of field research yielded the following results, which have been summarized. Based on the two year experiments, it could be established that profitability and productivity may be improved by the diversification of cropping system. The information concerning to the analysis of different Soybean based cropping systems under study, it may be concluded that. Soybean – Garlic cropping system is the most profitable cropping system of Vindhyan Plateau region. It returned 325.3 and 507.6 percentage higher profit as compared to the profit obtained under the existing and prevailing cropping systems like Soybean- Wheat, Soybean- Chickpea respectively in terms of system profitability counted in INR/hectare/day. Soybean – Garlic cropping system is the most productive cropping system of Vindhyan Plateau region.

Keywords: Cropping system, plant height and economic viability

Introduction

A significant group of crop plants called oilseeds produce oil that can be consumed by humans. There are around 40 different oilseeds whose oil can be ingested, but only a small number play an important role in the global trade. Throughout, oil crops are cultivated in a variety of agro-climatic conditions and are essential commodities in trade and commerce in many economies. The production spike was primarily brought on by the increasing demand for oilseed goods and was made feasible by breeding high yielding varieties as well as expanding the area under the crop. Soybean, followed by rapeseed, Mustard, cotton, peanut, and sunflower oilseeds, is the leading producer of oilseeds in the world (Sharma *et al.* 2011) [5]. Soybean has short growth season, it fits well in a variety of cropping systems and is well adapted for intercropping with a variety of crops, improving land equivalent ratio and reducing risk in rainfed circumstances due to climatic uncertainties. Crop rotations have long been known to help farmers and agricultural scientists interrupt the cycles of insects and diseases, lessen weed growth, stop erosion, add nutrients to the soil, enhance soil structure. Given the large gap between national productivity (1 t ha⁻¹) and the production potentials of varieties bred in India (3 t ha⁻¹), as well as the fact that yield levels achieved in front-line demonstrations under real farm conditions have been around 2 t ha⁻¹, which is almost double of the national average yield, there are promising prospects for continuing the trends of accrued benefits in the future (Tiwari *et al.*, 2011) [2]. The amount of information on including these crops in a cropping system based on Soybean is limited, though. Keeping all above points in consideration, the present field investigation entitled "Diversification of Soybean based cropping systems in Vindhyan plateau region of Madhya Pradesh" was under taken in the Agriculture Research Farm, Rabindranath Tagore University, Mendua, Raisen during *Kharif* and *Rabi* seasons of the years 2020-21 and 2021-22.

Materials and Methods

The experimental farm of Agricultural Research Farm at Rabindranath Tagore University, Mendua, Raisen had all the facilities like seed, fertilizer, labour, irrigation, storage, equipment etc. Raisen District lies in the central part of Madhya Pradesh.

The District is situated between the latitude 22 47' and 23 33' north and the longitude 77 21' and 78 49' east. Raisen district falls in Central Highlands (Malwa and Bundelkhand), Hot Sub-humid (Dry) Eco-sub region (10.1) and Agro-Climatic Zone (Planning Commission), Central Plateau and Hills Region (VIII). Raisen is categorised in Agro Climatic Zone (NARP) Vindhya Plateau Zone of Madhya Pradesh. The experimental plot was levelled and soil was medium black clay loam. The field study included 8 crop-sequence treatments that were examined over the course of two years in a completely randomised block design with three replications on a fixed plot. The field study included 8 crop-sequence treatments that were examined over the course of two years in a completely randomised block design with three replications on a fixed plot. Since study was based on diversification of Soybean based cropping system therefore Soybean crop was used in Kharif season. In the Kharif seasons, short and medium-long Soybean varieties, JS 95-60 and JS 335, were planted, followed by Wheat (GW 322), Chickpea (JG 63), Mustard (Pusa Jaikisan), and Garlic (G 323) in the Rabi season. Thus, 8 cropping system treatments were evaluated in CRBD. Table provides the treatments' specifics.

Results

Based on the two year experiments, it could be established that profitability and productivity may be improved by the diversification of cropping system. The information concerning to the analysis of different Soybean based cropping systems under study, it may be concluded that. Soybean – Garlic cropping system is the most profitable cropping system of Vindhyan Plateau region. It returned 325.3 and 507.6 percentage higher profit as compared to the profit obtained under the existing and prevailing cropping systems like Soybean- Wheat, Soybean-Chickpea respectively in terms of system profitability counted in INR/hectare/day. Soybean – Garlic cropping system is the most productive cropping system of Vindhyan Plateau region. It gave 271.8 and 326.8 higher productivity in terms of Soybean equivalent yield as compared to the productivity obtained under the existing cropping systems Soybean-Wheat and Soybean-Chickpea under irrigated production system respectively. The economic viability of any technology determines whether growers will really use it. Technology's economic analysis includes cost of cultivation, product value, net financial returns, and profitability. T8: Soybean (JS 335) - Garlic (G 323) or with T7: Soybean (JS 95-60) - Garlic (G 323) was found to be more effective in terms of gross financial returns, net financial returns, benefit cost ratios, and system profitability when comparing the economic viability of various cropping systems. Regarding economic viability, the treatment involving a Wheat cropping sequence was found other better options. The Soybean-Garlic system (regardless of Soybean variety) is more productive and profitable system under irrigated conditions as compared to the prevalent Soybean-Wheat or Soybean-Chickpea cropping systems, according to field experiments carried out at the agricultural research complex at Rabindranath Tagore University, Mendua, Raisen, for a period of two years during the years 2020-21, 2021-22. Considering the overall picture of the aforementioned facts, it is possible to draw the conclusion that diversifying the current cropping system by introducing high-value crops based on consumer demand is a fantastic chance to increase crop production efficiency and profitability.

Discussion

Even though the Soybean plant's height was measured at various stages, this chapter focuses on height at harvest. The treatment T2 - Soybean (JS-335) - Wheat (GW-322) had a significantly higher plant height than T8 - Soybean (JS-335) - Garlic (G-323), which had the second-longest height of the Soybean plant however both the treatments were found at par. Treatment T₁ - Soybean (JS-9560) - Wheat (GW-322) recorded the lowest plant height followed by T₃ - Soybean (JS-9560) - Chick pea (JG-63). When compared to the plant height, the Soybean variety JS 335 shown to have a higher plant height compared to the JS 95-60 Soybean variety. This finding is supported by Uchariya *et al.* (2019) ^[1], they found height of JS 335 highest (85.12) amongst 10 genotypes including JS 95-60 that ranked 6th. Whereas Keisham *et al.* (2021) ^[4] revealed that JS 335 performed best in plant height in growth stages of 30 DAS, 45 DAS, 60 DAS and at maturity. Plant dry matter at harvest stage was found significantly different in 2021 and pooled data analysis. The highest plant dry matter was found in T₂ - Soybean (JS-335) - Wheat (GW 322) in pooled data followed by T₃ - Soybean (JS-9560) - Chick pea (JG-63) with non-significant difference to each other. The lowest dry matter was observed in T₁ - Soybean (JS-9560) - Wheat (GW-322). On an average, JS 335 variety showed higher dry matter than JS 9560 variety considering dry matter weight at 30 DAS and 60 DAS. Dry matter accumulation and their allocation in different plant parts are the key determinants for high yield. The higher dry matter of JS 335 variety is the result of higher plant height, higher branches per plant, higher number of pods, higher number of seeds per pod and grain weight. Uchariya *et al.* (2019) ^[1] also found similar findings in vertisols that Soybean variety JS 335 showed significant higher growth than JS 9560 in plant height, number of branches, leaf per plant and dry weight per plant. Wheat and Chickpea produced more grain and seeds under cropping sequence treatments with Soybean variety JS 95-60, but Mustard and Garlic produced more seed and bulbs under cropping sequence treatments with Soybean variety JS 335. Garlic had the highest production (12255 & 12008 Kg ha⁻¹), followed by Wheat (4661 & 4521Kg ha⁻¹). Kumar *et al.* 2020 ^[3] revealed that maximum yield in Rabi was obtained with Garlic followed by the Wheat. The nitrogen fixation and effects of leguminous crop converted into better yield of Rabi crops.

Conclusion

Based on the two year experiments, it could be established that profitability and productivity may be improved by the diversification of cropping system. The information concerning to the analysis of different Soybean based cropping systems under study, it may be concluded that: Soybean – Garlic cropping system is the most profitable cropping system of Vindhyan Plateau region. It returned 325.3 and 507.6 percentage higher profit as compared to the profit obtained under the existing and prevailing cropping systems like Soybean-Wheat, Soybean-Chickpea respectively in terms of system profitability counted in INR/hectare/day. The economic viability of any technology determines whether growers will really use it. The Soybean-Garlic system (regardless of Soybean variety) is more productive and profitable system under irrigated conditions as compared to the prevalent Soybean-Wheat or Soybean-Chickpea cropping systems, according to field experiments carried out at the

agricultural research complex at Rabindra Nath Tagore University, Mendua, Raisen, for a period of two years during the years 2020-21, 2021-22. Considering the overall picture of the aforementioned facts, it is possible to draw the conclusion that diversifying the current cropping system by introducing high-value crops based on consumer demand is a fantastic chance to increase crop production efficiency and profitability.

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