**Original Research Article**

**Association Studies of Different Organic and Inorganic Fertilizers on Yield and Yield Attributes of Soybean (*Glycine max* L. Merr.) in Latur**

**Abstract**

A field experiment was conducted during *kharif* season of 2019 at the Experimental Farm, Department of Agronomy College of Agriculture, Latur. The objective of the experiment was to find out the association analysis between yield and yield attribute of soybean. The experiment was laid out in a randomized block design with nine treatments and replicated thrice. The treatments were T1 – 100 % RDF, T2 – 100 % RDF + FYM @ 5 t ha-1, T3 – 75 % RDF + FYM @ 5 t ha-1, T4 – 100 % RDF + FYM @ 2.5 t ha-1, T5 – 75 % RDF + FYM @ 2.5 t ha-1, T6 – 100 % RDF + Vermicompost @ 2.5 t ha-1, T7 – 75 % RDF + Vermicompost @ 2.5 t ha-1, T8 – 100 % RDF + FYM @ 5 t ha-1 + Vermicompost @ 1.25 t ha-1, T9 – 75 % RDF + FYM @ 5 t ha-1 + Vermicompost @ 1.25 t ha-1. Data on simple correlation between seed yield plant-1 (g) as dependent variable and plant height (cm), number of branches plant-1, number of functional leaves plant-1, mean leaf area plant-1, number of branches plant-1, total dry matter plant-1 (g), number of nodules plant-1, number of pods plant-1, Test weight (g) and oil content (%) as an independent variable were established. Result revealed that, positive and highly significant correlation were observed between seed yield plant-1 and plant height (0.909\*\*), number of branches plant-1 (0.915\*\*), number of functional leaves plant-1 (0.897\*\*), mean leaf area plant-1 (0.931\*\*), No. of branches plant-1 (0.935\*\*), total dry matter plant-1 (0.813\*), number of nodules plant-1 (0.971\*\*), number of pods plant-1 (0.895\*\*), Test weight (0.173) and protein content (0.702).

**Keyword:** *Association analysis, Correlation, Nutrient and RBD*

1. ***Introduction***

Soybean (*Glycine max* L. Merill) is a leguminous crop that belongs to family Leguminoaceae with sub family papillionaceae. The soybean originated in China and was brought to India in recent years. Soybean is a crucial commodity for human and animal nutrition, serving as a primary source of edible vegetable oil and high-protein feed globally. It is a great health meal containing 40-44% protein, 20% oil, 3.3-6.4% ash and 24-26% carbohydrate. Furthermore, it also contains numerous vitamins and minerals. Soybean protein is rich in important amino acid lysine (5%) and may be used to a multitude of purposes. It is rich in minerals such as phosphorus, calcium and vitamins (Vitamins B, C and E). Soybean being richest, cheapest and simplest sources of highest quality protein, fat and also having a broad variety of applications as food and industrial product is often dubbed as “Wonder Crop”. A total of 120.50 Mha produces 333.67 Mt of soy beans worldwide in 2019-20. Brazil produces the most soya beans, with 114.27 Mt, followed by Argentina (55.26 Mt), and the United States (96.79 Mt). China (15.73 Mt) and India (13.27 Mt) contributes for 34.25, 29.01, 16, 56, 4, and 3,98 per cent of world output. India ranks fourth in the world with 11.34 hectares (28.02 million acres), or 9.41 per cent of the world's land area, and placed fifth in terms of output with 11.22 Mt in 2019-20. According to the first advance estimates of 2021-22 of Ministry of Agriculture, Soybean output is anticipated at 127.20 lakh tonnes as compared to 128.97 lakh tonnes in 2020-21. As of September 17, 2021, India's area planted with soy beans for the 2021-22 growing season was 121.76 lakh ha, up from 121.20 lakh ha in the 2020-21 growing season. With 55.84 lakh ha, Madhya Pradesh topped the states, followed by Maharashtra (46.01 lakh ha), Rajasthan, Haryana (10.62 lakh ha), Karnataka (3.82 lakh ha), Gujarat (2.24 lakh ha), and Telangana (1.51 lakh ha). Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Andhra Pradesh, Chhattisgarh, and Gujarat are the primary soybean-producing states in India. With Maharashtra, 4.124012 Mha of land are planted in soybeans, producing 4.82 Mt at a productivity of 1170.13 kg/ha in 2019 20. (Source-http:/Krushimaharashtra.gov.in/). The main soybean farming districts in Maharashtra include Nagpur, Wardha, Satara, Amravati, Chandrapur, Buldhana Parbhani and Latur. In 2019–20, the Wardha district will span 0.113028 Mha, produce 0.1474.10 Mt, and generate 1304.19 kg/ha. In the Vidarbha region, soybean is progressively replacing crops like cotton, sorghum, pigeon pea, etc. The increased demand for soybeans as a replacement crop has been one of the most significant economic motives for switching land from these crops to its production and pricing trends for the soy crop. (Source-http:/Krushimaharashtra.gov.in/). The production of soybean in Maharashtra and other locations is limited by climatic variables including unpredictable rainfall and distribution patterns, combined with controllable issues such as poor organic matter status owing to uneven fertilizer use. Integrated Nutrient Management (INM) techniques, including organic and inorganic nutrient sources, are critical for conserving soil fertility and enhancing soybean output (Anonymous, 2016). Continuous use of chemical fertilizers adds to soil fertility deterioration, underlining the necessity for balanced fertilization solutions. Research suggests that mixing organic manures with chemical fertilizers promotes nutrient availability and protects soil health, thereby enhancing crop output (Alam *et al*., 2010; Hati *et al*., 2007; Ramesh *et al*., 2010). To satisfy rising industrial needs and handle concerns like population pressure and climate change, enhancing soil nutrient management becomes vital. Efficient usage of organic and inorganic resources, with biofertilizers, is necessary for attaining sustainable soybean production (Anonymous, 2016). In implementing environmentally sound and economically viable agricultural practices, such as integrated nutrient management, is vital for guaranteeing the long-term productivity and sustainability of soybean agriculture in Maharashtra and beyond (Abebe and Deressa, 2017).

**Material and Methods**

A study was carried out during the *kharif* season of 2019 at the Experimental Farm, Department of Agronomy, College of Agriculture, Latur, Maharashtra. The trial had a randomised block design with nine treatments, each reproduced three times. The treatments were as follows: T1 - 100% Recommended Dose of Fertiliser (RDF); T2 - 100% RDF + Farmyard Manure (FYM) at 5 tonnes per hectare; T3 - 75% RDF + FYM at 5 tonnes per hectare; T4 - 100% RDF + FYM at 2.5 tonnes per hectare; T5 - 75% RDF + FYM at 2.5 tonnes per hectare; T6 - 100% RDF + Vermicompost at 2.5 tonnes per hectare; T7 - 75% RDF + Vermicompost at 2.5 tonnes per hectare; T8 - 100% RDF + FYM at 5 tonnes per hectare + Vermicompost at 1.25 tonnes per hectare; T9 - 75% RDF + FYM at 5 tonnes per hectare + Vermicompost at 1.25 tonnes per hectare. Alongside grain and straw yield, yield characteristics were also documented. The experimental data underwent correlation analysis to ascertain the Pearson coefficient, which characterises the relationship between various variables. The significant results of the inquiry are detailed and analysed below.

**Result and Discussions**

Data on simple correlation between seed yield plant-1 (g) as dependent variable and plant height (cm), number of branches plant-1, number of functional leaves plant-1, mean leaf area plant-1, number of branches plant-1, total dry matter plant-1 (g), number of nodules plant-1, number of pods plant-1, Test weight (g) and oil content (%) as an independent variable were established and resultant data presented in Table 1.

The correlation analysis of different plant attributes revealed significant relationships among key growth, yield, and quality parameters, providing valuable insights into their interdependencies. Plant height exhibited a strong positive correlation with most growth and yield attributes, including the number of functional leaves per plant (r = 0.965\*\*), leaf area per plant (r = 0.958\*\*), number of branches per plant (r = 0.969\*\*), dry matter accumulation (r = 0.975\*\*), number of nodules per plant (r = 0.958\*\*), and number of pods per plant (r = 0.993\*\*), indicating that taller plants tend to have a greater canopy, higher dry matter accumulation, and increased reproductive structures, all of which are crucial for enhanced productivity. Similarly, plant height showed a significant correlation with protein content (r = 0.889\*\*) and seed yield per plant (r = 0.909\*\*), emphasizing its role in improving both yield and quality traits. The number of functional leaves per plant was also positively correlated with various traits, particularly leaf area (r = 0.926\*\*), number of branches per plant (r = 0.924\*\*), dry matter accumulation (r = 0.911\*\*), number of nodules (r = 0.949\*\*), and number of pods per plant (r = 0.942\*\*), suggesting that plants with more leaves not only have a greater photosynthetic capacity but also support higher dry matter production and yield formation. The strong correlation between the number of leaves and seed yield (r = 0.915\*\*) further reinforces this relationship. Leaf area per plant exhibited highly significant correlations with number of branches (r = 0.969\*\*), dry matter accumulation (r = 0.942\*\*), number of nodules (r = 0.945\*\*), number of pods (r = 0.963\*\*), and seed yield per plant (r = 0.897\*\*), underscoring its importance in optimizing growth and yield potential through enhanced light interception and assimilation. The number of branches per plant was positively associated with dry matter accumulation (r = 0.928\*\*), number of nodules (r = 0.970\*\*), number of pods (r = 0.973\*\*), protein content (r = 0.843\*\*), and seed yield (r = 0.931\*\*), indicating that plants with more branches contribute to greater yield components. Dry matter accumulation showed significant correlations with number of pods per plant (r = 0.975\*\*), protein content (r = 0.956\*\*), and seed yield per plant (r = 0.813\*), highlighting its crucial role in determining final productivity. Likewise, the number of nodules per plant correlated significantly with seed yield per plant (r = 0.971\*\*), indicating the role of nitrogen fixation in enhancing grain yield. The number of pods per plant was one of the strongest predictors of seed yield per plant (r = 0.895\*\*), demonstrating that an increase in reproductive structures translates directly into higher productivity. Protein content also showed a moderate correlation with seed yield (r = 0.702), indicating that while yield and quality are interrelated, additional factors may influence protein content. Interestingly, test weight exhibited a weak correlation with most growth and yield parameters, including seed yield (r = 0.173), suggesting that test weight may be influenced more by genetic factors or environmental conditions rather than direct physiological growth parameters. Overall, these correlations emphasize that plant growth attributes such as height, number of functional leaves, leaf area, and dry matter accumulation play a significant role in determining reproductive success and seed yield. The strong associations among yield components, particularly the number of pods per plant, number of nodules, and dry matter accumulation, suggest that optimizing these traits through agronomic management or breeding selection could significantly enhance productivity and seed quality. Similar findings revealed by Jadhav *et al*. (2007), Kasu-Bandi *et al*. (2019), Kakabouki *et al*. (2022) and Turabi *et al*. (2024).

**Conclusion**

Application of 100% RDF + FYM at 5 t ha-1 + Vermicompost at 1.25 t ha-1 was recorded higher values of all the growth, yield and quality attributes of soybean followed by the application of 75% RDF + FYM at 5 t ha-1 + Vermicompost at 1.25 t ha-1, 100% RDF + FYM at 5 t ha-1, 100% RDF + FYM at 2.5 t ha-1 and 100% RDF + Vermicompost at 2.5 t ha-1 under rainfed condition. Above conclusion are based on single season research finding and it needs further confirmation by repeating the trial for at least one more season. The correlation analysis highlights the intricate relationships between plant growth, yield, and quality traits, offering valuable insights into factors that influence crop productivity. Traits such as plant height, the number of functional leaves, leaf area, and dry matter accumulation play a fundamental role in enhancing reproductive success and seed yield. The strong associations observed between key yield components, particularly the number of pods, nodules, and biomass—suggest that improving these traits through better agronomic practices, nutrient management, and selective breeding could significantly enhance overall crop performance.

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**Table 1: Simple correlation (r) of seed yield plant-1 with growth, yield and quality attributes**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Particulars** | Plant height (cm) | No. of functional Leaves plant-1 | Leaf area plant-1 (dm2) | No. of branches Plant-1 | Dry matter Plant-1 (g) | No. of nodules plant-1 | No. of pods plant-1 | Test weight (g) | Protein content (%) | Seed yield plant-1 (g) |
| Plant height (cm) | **1** | 0.965\*\* | 0.958\*\* | 0.969\*\* | 0.975\*\* | 0.958\*\* | 0.993\*\* | 0.258 | 0.889\*\* | 0.909\*\* |
| No. functional leaves plant-1 |  | **1** | 0.926\*\* | 0.924\*\* | 0.911\*\* | 0.949\*\* | 0.942\*\* | 0.265 | 0.772\* | 0.915\*\* |
| Leaf area plant-1 (dm2) |  |  | **1** | 0.969\*\* | 0.942\*\* | 0.945\*\* | 0.963\*\* | 0.103 | 0.857\*\* | 0.897\*\* |
| No. of branches Plant-1 |  |  |  | **1** | 0.928\*\* | 0.970\*\* | 0.973\*\* | 0.104 | 0.843\*\* | 0.931\*\* |
| Dry matter plant -1 (g) |  |  |  |  | **1** | 0.895\*\* | 0.975\*\* | 0.258 | 0.956\*\* | 0.813\* |
| No. of nodules plant-1 |  |  |  |  |  | **1** | 0.962\*\* | 0.077 | 0.790\* | 0.971\*\* |
| No. of pods plant-1 |  |  |  |  |  |  | **1** | 0.164 | 0.899\*\* | 0.895\*\* |
| Test weight (g) |  |  |  |  |  |  |  | **1** | 0.224 | 0.173 |
| Protein content (%) |  |  |  |  |  |  |  |  | **1** | 0.702 |
| Seed yield plant-1 (g) |  |  |  |  |  |  |  |  |  | **1** |

***\* Significance at five per cent: 0.706 \*\* Significance at one per cent: 0.834***