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Comparative Efficacy of Natural Farming, Organic and Inorganic Systems of Nutrition in Transplanted Rice

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ABSTRACT: Continuous use of chemical fertilizers has been reported to cause various detrimental effects on physical and chemical properties of soils and ecological pollutions. Use of organics (FYM, Jeevamrit etc.) are eco-friendly and sustain productivity but their limited availability and low nutrient status are major constraints. Under the situation, the addition of organic manures in combination with chemical fertilizers is reliable option. Therefore, to study the comparative efficacy of natural farming, organic and inorganic systems of nutrition in transplanted rice the present study was conducted at the Research Farm of the School of Agriculture, Abhilashi University, Mandi (H.P.) during Kharif 2022. Six nutrient management treatments were tested in randomized block design with three replications. Results of study revealed that inorganic nutrient management and integrated nutrient management i.e. 50 per cent recommended dose of fertilizers + FYM @5 t/ha behaving alike resulted in better crop growth (plant height, number of tillers and dry matter accumulation), yield attributes (number of effective tillers, number of grains per panicle and 1000-grain weight) and higher yield (grain and straw) of transplanted rice than farmer's practice (FYM @2.5 t/ha + 25 per cent recommended dose of fertilizers) and organic (biofertilizers + Jeevamrit + FYM @10 t/ha) as well as natural farming nutrient management (Beejamrit + Jeevamrit + Ghanjeevamrit) practices.

Keywords: Nutrient management, fertilizer, transplanted rice, organic, natural farming, integrated.

INTRODUCTION

Rice (*Oryza sativa* L.) forms the staple food for more than half of the world's population. In India, crop is grown throughout the year occupying an area of 45.07 million hectares with production of 122.27 million tones and productivity of 2713 kg/ha (Anonymous, 2021). In Himachal Pradesh, it occupies an area of 68.46 thousand hectares with a total production of 138.46 thousand tones and productivity of 2022.61 kg/ha (Anonymous, 2021). Chemical fertilizers have the ability to fulfil the nutrient demand of crop. But continuous use of chemical fertilizers in paddy crop has been reported to cause an imbalance of nutrients in soils with adverse effects on soil health and also on crop yield (Sharada *et al*., 2018). Under the situation, the use of organic manures assumed greater significance in the present set-up of agriculture. Organic manures have the capacity to fulfill the nutrient demand of crops adequately and promote the activity of beneficial macro and microflora in the soil, improve soil physical and chemical properties that ultimately improve soil fertility status and hence, reduce the need for inorganic fertilizers (Rameshwar *et al.,* 2014). Biofertilizers, an alternate low-cost resource has gained prime importance in recent decades and play a vital role in maintaining long-term soil fertility and sustainability.

Although, organics are eco-friendly and sustain productivity but their limited availability and low nutrient status are major constraints in the use of these alternative sources of plant nutrients. Under this situation, the addition of organic manures and biofertilizers in combination with chemical fertilizers may be helpful and serve as a supplementary source of nutrients in economizing the use of nutrients. In recent years, a new concept of Subhash Palekar's Natural Farming (SPNF) has also been proposed. One of the major components of this farming is the rearing of indigenous cattle whose urine and dung are critical ingredients of preparations like Beejamrit, Jeevamrit and Ghanjeevamrit. Jeevamrit is a fermented microbial culture when applied to soil, adds nutrients to the soil besides acting as a catalytic agent to promote the activity of microorganisms and earthworms in the soil (Saharan *et al.,* 2023). Jeevamrit is claimed to be a panacea for natural farming. But this needs experimental testing on long-term basis. Therefore, an attempt has been made to study the comparative efficacy of different nutrient management practices in transplanted rice.

MATERIAL AND METHODS

A field experiment was conducted during Kharif 2022 at the Research Farm of the School of Agriculture, Abhilashi University, Mandi (H.P.) situated at 31°33′ N

latitude and 78°53′E longitude at an elevation of about 1408 meters above mean sea level in north-western Himalayas. Soil of the experimental field was acidic in reaction (pH 5.5), medium in organic carbon (0.67%), low in available nitrogen (230 kg/ha), medium in available phosphorus (14.12 kg/ha) and available potassium (211 kg/ha) content. The experiment was laid out in randomized block design with three replications comprised of six nutrient management treatments i.e. absolute control (T_1), natural farming nutrient management (seedling treatment with Beejamrit + soil treatment with Jeevamrit as basal and at 21 days interval + Ghanjeevamrit @250 kg/ha) (T_2), organic nutrient management (soil treatment with biofertilizers + Jeevamrit as basal + FYM @10 t/ha + Himsols-3 spray at 15, 30 and 45 DAT) (T_3), farmer's practice (FYM @2.5 t/ha + 25 per cent recommended dose of fertilizers) (T_4), integrated nutrient management (FYM @5 t/ha + 50 per cent recommended dose of fertilizers) (T_5) and inorganic nutrient management (100 per cent recommended dose of fertilizers) (T_6).

'PAC 807' variety of transplanted rice was grown. Seedlings of transplanted rice were sown in row to row spacing of 20 cm and hill to hill spacing of 10 cm. Prior to sowing, full dose of FYM on a dry weight basis was applied as per treatment and thoroughly mixed with the puddled soil. The crop was fertilized with a recommended dose of nitrogen, phosphorous and potassium i.e. 90, 40, 40 kg/ha through urea, single super phosphate and murate of potash as per treatment at the time of transplanting. Half dose of N, whole of P and K as per treatment was drilled at the time of transplanting of the crop. The remaining half of the nitrogen was top dressed in two equal splits at active tillering stage and 3 weeks after first top dressing. Beejamrit was prepared on the farm itself as per the seedling requirement. The ingredients for 1 liter of Beejamrit were local cow dung (200 g), local cow urine (200 ml), lime (2 g), soil (8 g) and water (800 ml). Thereafter, 24 hours of preparation, the roots of seedling were dipped in Beejamrit for 15 minutes and then transplanted. The ingredients for 2 liters of Jeevamrit were cow dung (100 g), cow urine (100 ml), jaggery (20 g), pulse floor (20 g), soil (2 g) and water (2 liters), dilution of 10 per cent from the concentrated Jeevamrit was prepared and used at the rate of 500 l/ha in the respective treatments. Ghanjeevamrit (250 kg) was prepared on the farm itself using dried and sieved desi cow dung (250 kg) and Jeevamrit (25 liters). Jeevamrit was added to dried and sieved cow dung and contents were mixed. Balls were made with hand and dried under shade for 48 hours. Thereafter, Ghanjeevamrit was ready to use. Ghanjeevamrit was broadcasted @ 250 kg/ha in the puddled soil at the time of transplanting. Himsol (2 liters) was prepared on farm itself using local cow dung (750 g), cow urine (150 g), vermicompost (900 g), small copper piece (1), ash (5g) and water (2 liters). Dilution of 10 per cent from the concentrate Himsol was prepared and used at the rate of 500 l/ha in the respective treatments. All the inputs of natural farming were prepared as per the procedure proposed by Subhash Palekar (Palekar, 2006).

The observations on growth characteristics, yield attributes and yield of transplanted rice were recorded through standard procedures. The data pertaining to these observations were subjected to the statistical analysis using analysis of variance as per procedure suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth parameters: The growth attributes of transplanted rice viz. plant height (cm), number of tillers (per m^2) and dry matter accumulation (g/m^2) were significantly affected by different nutrient management treatments at 90 days after transplanting. Inorganic nutrient management remaining at par with integrated nutrient management i.e. FYM @5 t/ha + 50 per cent recommended dose of fertilizers resulted in significantly taller plants, higher number of tillers and dry matter accumulation than other nutrient management treatments. Farmer's practice of FYM @2.5 t/ha + 25per cent recommended dose of fertilizers was next in place to inorganic and integrated nutrient management treatments, however remained statistically at par with organic nutrient management treatment comprised of biofertilizers + Jeevamrit + FYM @10 t/ha + Himsol. Natural farming nutrient management treatment i.e. Beejamrit + Jeevamrit + Ghanjeevamrit remaining at par with absolute control failed to exhibit significant improvement in growth parameters of transplanted rice.

Improvement in growth parameters of transplanted rice owing to fertilizers application under inorganic and integrated nutrient management might be due to more nutrient availability, particularly nitrogen which stimulates cell division and cell elongation thus enhanced vegetative growth. Arif *et al.* (2014); Mahmud *et al*. (2016) also obtained better dry matter accumulation of transplanted rice with inorganic and integrated nutrient management practices which was ascribed to more availability of nutrient in soil and their assimilation by plants. In organic and natural farming nutrient management, nutrients supplied through FYM, Himsol, Beejamrit, Jeevamrit and Ghanjeevamrit could not adequately meet the nutrient requirement of crop.

Yield attributes: The yield attributes of transplanted rice viz. number of effective tillers (per m^2) and number of grains per panicle was significantly influenced by different nutrient management treatments. However, treatments did not have any significant influence on the 1000-grain weight of transplanted rice. Significantly higher number of effective tillers and number of grains per panicle was recorded with inorganic nutrient management, which remained statistically at par with integrated nutrient management treatment comprised of FYM @5 t/ha + 50 per cent recommended dose of fertilizers. The best treatments were followed by farmer's practice of FYM @2.5 t/ha + 25per cent recommended dose of fertilizers. Comparison between organic (biofertilizers + Jeevamrit + FYM @10 t/ha + Himsol) and natural farming (Beejamrit + Jeevamrit + Ghanjeevamrit) nutrient management treatments revealed no significant difference between the treatments, however, organic nutrient management

resulted in higher number of effective tillers and number of grains per panicle of transplanted rice. Significantly lower number of effective tillers and grains per panicle was recorded under absolute control, which did not differ significantly from natural farming nutrient management treatment.

Rapid mineralization of N from inorganic fertilizers and steady supply of N from organics, might have meet the nitrogen requirement of crop during the entire growth period leading to higher yield and yield components. Similar results regarding higher number of effective tillers, number of grains per panicle and grain weight per panicle with the application of inorganic nutrient management and integrated nutrient management has also been reported by Sutar *et al.* (2019).

Yield: The data pertaining to grain and straw yields of transplanted rice have been given in Table 2. Inorganic nutrient management resulted in significantly higher grain and straw yields of transplanted rice, which was statistically at par with the integrated nutrient management treatment comprised of FYM @5 t/ha + 50 per cent recommended dose of fertilizers. Following to inorganic and integrated nutrient management, farmer's practice of FYM @2.5 t/ha + 25 per cent recommended dose of fertilizers resulted in significantly higher grain and straw yields of transplanted rice than rest of the treatments. Comparison of organic nutrient management treatment i.e. biofertilizers + Jeevamrit + FYM @10 t/ha + Himsol with natural farming nutrient management treatment i.e. Beejamrit + Jeevamrit + Ghanjeevamrit revealed that organic nutrient management produced higher grain and straw yields, but remained statistically at par with natural farming nutrient management treatment. Significantly lower grain and straw yields was recorded with absolute control which was statistically at par with natural farming nutrient management treatment. Inorganic nutrient management resulted in 49.36, 39.82, 30.11, 18.29 and 4.89 per cent more grain yield and 49.36, 41.86, 31.34, 19.38 and 7.46 per cent more straw yield over absolute control, natural farming nutrient management, organic nutrient management, farmer's practice and integrated nutrient management, respectively.

The results manifestly revealed that better vegetative growth (plant height, number of tillers and dry matter accumulation) coupled with high yield attributes (effective tillers and number of grains per panicle) under inorganic and integrated nutrient management practices ultimately results in better grain and straw yields compared to farmer's practice and treatments having organic and natural farming sources of nutrients. Similar results were reported by Hasanuzzaman *et al*. (2010) ; Tomar *et al*. (2018) obtained higher grain and straw yields of transplanted rice with inorganic and integrated nutrient management due to adequate availability of nutrients in soil solution which increased the root growth and there by uptake of nutrients. Improvement in physical, chemical and biological properties of soil through the application of organic manure with chemical fertilizers might have also responsible for higher yield under integrated nutrient management (Singh *et al*., 2016).

Table 1: Effect of nutrient management practices on growth parameters of transplanted rice.

Treatments	90 days after transplanting		
	Plant height (cm)	Number of tillers (per m^2)	Dry matter accumulation (g/m^2)
Absolute control	69.2	216	381.33
Natural farming nutrient management	75.0	235	462.60
Organic nutrient management	79.3	249	536.47
Farmer's practice	86.1	283	660.80
Integrated nutrient management	96.5	315	789.34
Inorganic nutrient management	97.3	322	855.10
SEm±	3.2	10.18	28.41
CD(P)=0.05	9.5	30.55	82.69

Table 2: Effect of nutrient management treatments on yield attributes and yield of transplanted rice.

Treatments	Number of effective tillers (m^2)	Number of grains per panicle	1000-grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Absolute control	168	67	22.3	2107	3033
Natural farming nutrient management	187	71	22.5	2503	3703
Organic nutrient management	214	76	22.7	2898	4367
Farmer's practice	249	80	22.9	3393	5135
Integrated nutrient management	280	85	23.0	3949	5894
Inorganic nutrient management	289	87	23.2	4152	6369
SEm±	10	3	0.3	151	229
CD(P)=0.05	30	8	NS	453	687

CONCLUSIONS

The study conclusively indicated that inorganic and integrated nutrient management proved superior to organic farming and natural farming nutrient management in terms of growth attributes (plant height, number of tillers and dry matter accumulation), yield attributes (number of effective tillers and number of grains per panicle) and yield (grain and straw) of transplanted rice.

FUTURE SCOPE

Integrated nutrient management can be best practice to increase the productivity of transplanted rice as compared to other practices of organic and natural farming nutrient management.

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Conflict of Interest. None.

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