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Varietal diversification for enhanced productivity and profitability under diverse production systems

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Mustard [*Brassica Juncea* (L.) Czern & Coss] is an important oilseed crop belonging to family Brassicacae. During the last two decades, the domestic consumption of vegetable oils increased at a CAGR of 4.3% and is expected to continue increasing with the growing population, changing demographic pattern and rising per capita consumption due to increased GDP (Rathore *et al*. 2020). It gives immense scope to increase the production in traditional and non-traditional areas in India with proper inputs, technological interventions, and suitable policy framework. Crop diversification has emerged an important alternative to attain the objectives of output growth, employment generation and natural resource sustainability. The diversified agriculture also ensures food security and improves the quality of life by adding to the nutritional security. In almost all the states, use of improved varieties has significantly increased the yield. In addition, fertilizer was the most critical input for realizing higher yields of rapeseed-mustard, since intensification of the Indian agriculture has led to marked deficiency of different nutrients in the soil. Thus, replenishment of nutrients through organic and inorganic sources to increase as well as sustain production is needed. Use of balanced fertilization by the application of nitrogen, phosphorus, potassium, sulphur along with farmyard manure and biofertilizers, viz. *Azotobacter* and *Azospirillium* is of great significance to attain maximum economic yield without any deleterious effects on ecological balance. Information in this respect is meagre, hence to meet the national targets and increase seed yield through adoption of technology inputs, as well as to meet the international targets of quality oilseed, the present investigation was carried to study the effect of different production systems on growth, yield attributes, productivity and economics of mustard varieties, nutrient uptake and soil health.

Field experiment was conducted at ICAR-IARI, New Delhi during *rabi* 2020–21. The experiment was conducted at research farm of the division of Agronomy, Indian Agricultural Research Institute, New Delhi (28.63 °N latitude, 77.15 °E longitude, 228.6 m above mean sea level). The field has an even topography and good drainage system. Soil of the experimental field belongs to the order *Inceptisol* having sandy loam texture in top 30 cm layer. Composite soil sampling was accomplished from 0–15 cm depth randomly before sowing of the crop from different spots of the field by using core sampler and then the sample was shade-dried followed by oven drying at 105°C; it was grounded and sieved through a 2 mm sieve for further analysis of soil physical and chemical properties. The samples were analyzed for major plant nutrients and also for the physico-chemical properties of soil. The field experiment was laid-out in split-plot design in fixed layout with three replications. The field experiment comprised four main plot treatments (production systems: Organic, Integrated, Conventional and Conservation agriculture) and three sub-plot treatments (mustard varieties-PM 26, PM 28 and PDZ 1). Sowing was done on 22nd October, 2020 using 'happy seeder' after application of 60 mm irrigation and harvested on 6th March 2021.

Effect on seed, stover and biological productivity of mustard: The examination of data (Table 1) showed that there was significant difference in mustard yield (seed, stover and biological yield) due to diverse production systems and in different varieties. The seed yield of mustard was significantly high under ICM (2259.0 kg/ha), which was significantly superior to seed yield produced under remaining production systems. There was almost 14% increase in seed yield under ICM compared to CS, but lower seed yield was recorded under OMS than obtained under CS. However, under CA, higher seed yield was harvested than it was under CS. Among the mustard varieties, PM 26 resulted in maximum seed yield (2206 kg/ha), closely followed by PM 28 (2123 kg/ha), while least seed yield

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Table 1 Effect of varietal diversification on seed, stover, biological yield and B:C ratio of Indian mustard under diverse production systems

Treatment	Seed yield (kg/ha)	Stover yield (kg/ha)	Biological yield (kg/ha)	B:C ratio
Production systems				
Organic Management System	1934	6906	8840	2.61
Integrated Crop Management	2259	6985	9244	2.70
Conventional System	1986	6920	8928	3.12
Conservation Agriculture	2008	7950	9936	3.30
SE(m)±	72.3	434.2	478.8	0.12
LSD (P≤0.05)	250.2	1502.5	1656.8	0.43
Variety				
Pusa Mustard 26	2206	8505	10711	3.22
Pusa Mustard 28	2123	6536	8659	3.07
Pusa Double Zero-1	1810	6530	8341	2.51
SE(m)±	40.7	310.5	334.9	0.07
LSD (P≤0.05)	122.1	930.8	1003.9	0.21

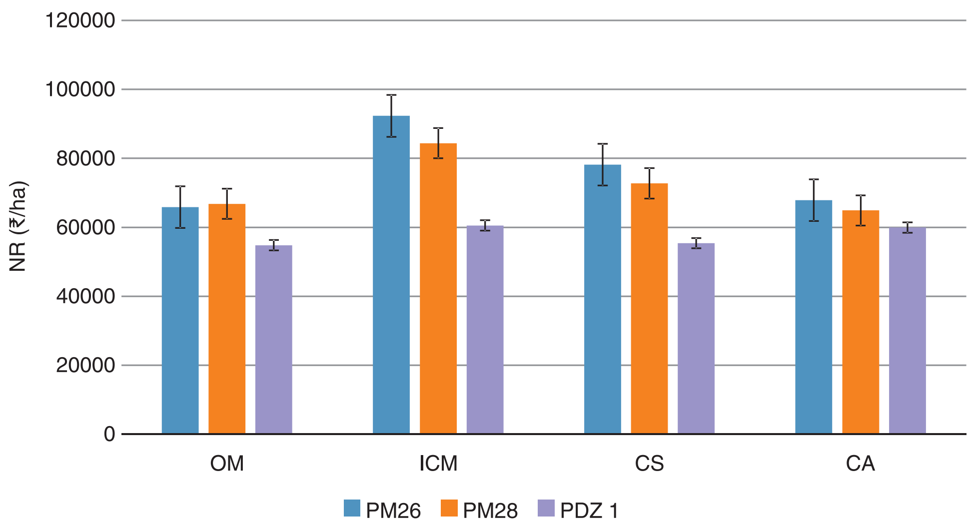

Fig 1 Net return (₹/ha) due to varietal diversification under diverse production systems.

was recorded under PDZ-1. Interestingly, higher stover yield (7950 kg/ha) was recorded under CA and remaining production system received almost similar stover yield, while biological yield again remained higher under CA, followed by biological yield under ICM (9244 kg/ha). Among the mustard varieties PM 26 was recorded with higher stover (8505 kg/ha) and biological yield (10711 kg/ha), whereas stover and biological yield remained low in PM 28 and PDZ-1 (Table 1). Application of fertilizer integrated with organic manure to pearl millet crop left behind sufficient residual effect, which tended significant increase in yield attributes and seed yields of mustard (Asoodari *et al*. 2001, Premi *et al.* 2005).

Effect on economics of mustard: The economics of mustard crop was analyzed in terms of net returns and B:C ratio depicted in Fig 1 and Table 1. The maximum NR was obtained under ICM (₹76583/ha) and among the varieties, PM 26 gave maximum NR of ₹76,060.0 /ha. It is evident higher net return was simply due to higher seed yield of crops under these treatments. B:C ratio was also influenced by diverse production systems in different varieties, it ranged from 2.51–3.22. CA and CS resulted in higher B:C ratio (3.3 and 3.12, respectively) compared to OMS and ICM, while among the varieties maximum B:C ratio was recorded from PM 26 (3.22) and least was from PDZ-1 (2.51) (Hati *et al*. 2006, Rathore *et al*. 2016 and Kumar 2018). Therefore, the shift from the regional dominance of one crop (cereal) to regional production of a number of crops and their suitable varieties takes into account the economic returns from different value-added crops with complementary marketing opportunities. Further, diversification can be designed to help poverty alleviation, employment planning and environmental conservation. A planned diversification increases socio-economic gains to the farmers (Rathore *et al.* 2019).

SUMMARY

A field experiment was conducted during *rabi* 2020–21 to study the effect of different production systems on yield and economics of mustard varieties. The seed yield of mustard crop was significantly high under ICM (2259.0 kg/ha), while maximum stover (7950 kg/ha) and biological yield (9936 kg/ha) was recorded under CA. Among the mustard varieties, PM 26 resulted in significantly higher seed (2206 kg/ha), stover (8505 kg/ha) and biological yield (10711 kg/ha). ICM gave maximum net returns of ₹76583/ha, while with respect to variety, PM 26 gave maximum net returns of ₹76060/ha. CA and CS resulted in higher B:C ratio (3.3 and 3.12, respectively) compared to OMS and ICM, while among the varieties maximum B:C ratio was recorded from PM 26 (3.22). Different production systems under different mustard varieties showed the positive impact on crop productivity as well as on economics. The varietal diversification of maize based system with Pusa mustard 26 and Pusa mustard 28 Indian mustard varieties gave maximum productivity, profitability under integrated crop management system.

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