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Research Communication

Effect of integrated nutrient management on the growth and yield of Yellow Sarson (*Brassica rapa var. yellow sarson*) under guava (*Psidium guajava*) based agri-horti system

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ABSTRACT

An experiment was conducted during the winter (*rabi*) season of 2021–22 to evaluate the effect of integrated nutrient management on the growth and yield of yellow sarson under guava based agri-horti system. The field experiment comprised 8 treatment, viz., T_1, Control; T_2, 100% RDF + 30 kg S + 5 kg Zn; T_3, 50% RDF + 15 kg S + 2.5 kg Zn + 2.5 t/ha FYM+ 2 spray of nano urea; T_4, 50% RDF + 15 kg S + 2.5 kg Zn + 5 t/ha FYM+ one spray of nano urea; T_5, 75% RDF + 22.5 kg S + 3.7 kg Zn + 2.5 t/ha FYM + 2 spray of nano urea; T_6, 75% RDF + 22.5 kg S + 3.7 kg Zn +5 t/ha FYM + 1 spray of nano urea; T_7, 100 % RDF + 30 kg S + 5 kg Zn + 2.5 t/ha FYM; T_8, 100% RDF + 30 kg S + 5 kg Zn + 5 t/ha FYM, was laid out in randomized block design, with 3 replications. The results revealed that application of 75% RDF + 22.5 kg S + 3.7 kg Zn +2.5 t/ha FYM + 2 spray of nano urea at 30-35 DAS and pre-flowering stage (T_5) gave significantly higher growth and yield attributes such as plant height (141.03 cm), dry matter accumulation (37.76 g/plant), no. of siliqua (142/plant), siliqua length (6.67 cm), test weight (3.43 g) as well as seed yield (1.49 t/ha) and stover yield (3.54 t/ha) as compared to control. The highest amount of nitrogen, phosphorus, potassium and sulphur uptake by plant was also observed in the treatment T_5. These findings provide valuable insights for farmers and researchers aiming to optimize nutrient management strategies and improve crop productivity in similar agri-horti systems.

Key words: Agri-horticulture, Guava, Integrated nutrient management, Yellow sarson, Yield

The combination of agricultural crops, mostly legume crops, and perennial fruit crops will give a very good source of revenue for farmers livelihood as well as promoting its products, making the agri-horti system the most desired system as opposed to other systems that exaggerate output (Lal *et al.,* 2014). The guava-rapeseed & mustard based agroforestry approach is considered to be the finest choice for intercropping. Guava (*Psidium guajava* L.) is a fast-growing fruit crop that can be planted throughout the country, with the exception of higher hills. Whereas, Rapeseed & Mustard is one of the most important oilseed crops (Raj *et al*., 2019). It is currently the world's third most important oilseed crop in terms of production and area. It occupied 8.8 million hectares, with a production of 12.4 million tonnes and a productivity of 1419 kg/ha for 2021-22 (Anonymous, 2022).

Now a days, use of inorganic fertilizers and pesticides has become an important tool to increase crop production. However, a major portion of the applied chemical fertilizer is lost through the leaching, runoff, emission and volatilization which resulted in economic losses and environmental problems. Integrated nutrient management (INM) plays a crucial role in enhancing soil fertility and plant nutrient availability, achieved through the synergistic combination of inorganic and organic fertilizers along with biofertilizers (Mohanty *et al*., 2019). Farmyard manure (FYM) is one of the important squares of nutrient management because it is cheap and easy to get which improves the soil physical, chemical and biological properties (Meena *et al*., 2021). However, a substantial amount of manure is normally recommended for a long-term and greater soil productivity (Cai *et al*., 2020). Inadequate use of organic manures and fertilizers as well as total reliance on chemical fertilizers

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has been recognized as major barriers to rapeseed & mustard production. The appropriate application of fertilizers helps to supply all the essential nutrients to plants which play a critical role in maximizing the yield potential of rapeseed & mustard. Additionally, crop nutritional deficiencies may be resolved with the use of nanotechnology. Nano fertilizers, with their unique properties, enhance plant performance by significantly boosting production through ultra-efficient absorption (Navya *et al*., 2022).

With the importance of the combined effect of organic and inorganic nutrients, present investigation was conducted to study the effect of integrated nutrient management on the growth and yield of yellow sarson under guava based agri-horti system.

The experiment was conducted during the winter (*rabi)* season of 2021-22 at the Agricultural Research Farm, Rajiv Gandhi South Campus, Banaras Hindu University, Barkachha, Mirzapur, Uttar Pradesh. This place typically experiences semi-arid to sub-humid climates, with high and low precipitation, moderate humidity, and seasonal temperature fluctuations. The seed loam sandy loam soil in the experimental field exhibited low levels of soil organic carbon (0.36%) and nitrogen (175.2 kg/ha), but high levels of potassium (157.68 kg/ha) and phosphorus (18.5 kg/ha). Both *p*H (6.5) and electrical conductivity (0.23 dS/m) of the soil were within the typical range. The experiment followed a randomized block design (RBD) with three replications. The study included eight treatments, namely Control (T_1), 100% RDF(80-40-40) kg/ha +30 kg S+5kg Zn (T_2), 50% RDF+15 kg S+2.5 kg Zn+2.5 t/ha FYM+two sprays of nano urea (T_3), 50% RDF+15 kg S+2.5 kg Zn+5 t/ha FYM+one spray of nano urea (T_4), 75% RDF+22.5kg S+3.7kg Zn+2.5 t/ha FYM+two sprays of nano urea (T_5), 75% RDF+22.5 kg S+3.7 kg Zn+5 t/ha FYM+one spray of nano urea (T_6), 100% RDF(80-40-40 kg/ha) +30kg S+5kg Zn+2.5 t/ha FYM (T_7), and 100% RDF(80-40-40) kg/ha +30 kg S+5 kg Zn+5 t/ha FYM (T_8). The gross and net plot sizes were: 5 m × 3 m and 4 m × 2.1 m, respectively.

After the final field preparation, the seeds of yellow sarson variety "Pitambari" was sown in furrows at the rate of 5 kg/ha at a uniform distance of 45 cm between rows and 15 cm distance between plant to plant, thinning is done after full emergence to maintain optimum plant population. The sowing was done in second fortnight of October between the alleys of eighteen years old guava plantation (Lucknow-49) which was planted in August 2006–2007 at spacing 7m×7m. Well-decomposed FYM was applied to all the experimental units as per different treatment combinations. The field was fertilized with recommended doses of N: P: K (80: 40: 40 kg/ha) for the rapeseed crop as per the treatment. The study employed urea, di-ammonia phosphate (DAP), muriate of potash (MOP), elemental sulphur and monozinc sulphate (MZS), respectively as sources of nutrients. Half dose of nitrogen and full dose of phosphorus, potassium, sulphur and zinc as per treatment were applied in furrows after mixing with moist soil. The rest half nitrogen was top dressed through urea after first irrigation. Nano urea is applied @ 500 ml/acre at initial growth stage 30–35 days after sowing and before flowering.

In each plot, 5 plants were tagged for taking all observations. Siliquae were picked at nearly 90% of the crop maturity stage. Seed yield was estimated on a per plot basis and converted to seed yield per hectare in tonnes. Statistical analysis was made to determine the significance between the means of treatment and to draw a valid conclusion. Data obtained from various parameters observations were analyzed statistically by adopting the appropriate "Analysis of Variance method''. The significance of the treatment effect was evaluated with the help of the 'F' test (Variance ratio).

The data revealed that application of 75% RDF + 22.5 kg S + 3.7 kg Zn + 2.5 t/ha FYM + 2 spray of nano urea (T_5) gave significantly higher plant height (141 cm) at harvest (Table 1). Increased plant height due to integration of organic and inorganic nutrients application are in accordance with that reported by Bhari *et al*. (2000). Significantly highest dry matter accumulation/plant (37.76 g) were observed with application of 75% RDF and 22.5 kg S + 3.7 kg Zn + 2.5 t/ha FYM + 2 spray of nano urea (T_5) over other nutrient management practices. The application of nitrogen and nano urea increases cell size, resulting in morphologically increased plant height also found that improved nutrition taller plants produced better chlorophyll synthesis, which increased photosynthesis and dry matter accumulation as a result of more chances for photosynthate generation (Sharma and Thkaral, 2023). In contrast, the control treatment, which received no fertilizer application, recorded the minimum dry matter accumulation due to the absence of any nutrient supplementation.

Significantly maximum numbers of siliqua/plant (142), siliqua length (6.67cm) and test weight (3.43 g) were recorded in treatment T_5, which was at par with T_6 and T_8. Significantly highest seed (1.4 t/ha) and stover (3.5 t/ha) yield were observed in the treatment T_5 as compared to all the treatments. Also, treatment T_5 recorded significantly higher biological yield (4.6 t/ha) and harvest index (29.61%) which were found at par with T_6 and T_8. (Table 1). The increase in seed, stover and biomass production might be attributed to improvements in growth and yield-attributing characteristics, as well as enhanced photosynthetic activity. A considerable increase in stover production might be attributed to enhanced dry matter accumulation beginning with the early stages of crop growth and lasting for 130 days under conditions of improved photosynthetic

Table 1. Effect of INM on various growth, yield attributes, yield and harvest index

Treatments*	Plant height (cm) at harvest	Dry matter accumulation (g/plant) at harvest	Number of siliqua/ plant	Length of siliqua (cm)	Test weight (g)	Seed yield (t/ha)	Stover yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
T_1	123.20	28.27	116	3.40	2.57	0.71	1.87	2.71	26.06
T_2	129.40	32.22	129	5.00	3.23	1.08	2.74	3.82	28.18
T_3	125.73	29.89	121	3.60	3.00	0.87	2.27	3.13	27.65
T_4	127.43	31.38	125	3.77	3.11	0.97	2.46	3.43	28.30
T_5	141.03	37.76	142	6.67	3.43	1.49	3.55	4.69	29.61
T_6	138.22	35.17	138	6.40	3.37	1.29	3.20	4.45	28.70
T_7	133.41	33.95	129	5.77	3.26	1.17	2.98	4.15	27.81
T_8	135.56	34.66	34	6.10	3.37	1.24	3.10	4.33	28.53
SEm±	2.00	0.41	3.83	0.36	0.06	0.05	0.10	0.17	0.47
CD (P=0.05)	6.14	1.26	11.74	1.11	0.10	0.14	0.32	0.51	1.45

*Treatment details are given under materials and methods section.

efficiency and nutrient accumulation. Singh *et al*. (2014) and Meena *et al.* (2021) also reported the same observation.

These results highlight the importance of INM and the use of nano urea in enhancing yield attributes and overall crop productivity in yellow sarson cultivation.

The INM treatment consisting of 75% RDF, 22.5 kg of S, 3.7 kg of Zn, 2.5 t/ha of FYM, and two sprays of nano urea (T_5) exhibited maximum harvest index (29.61%) and biological yield (4.6 t/ha). This treatment was statistically at par with the treatment involving 75% RDF, 22.5 kg S, 3.7 kg Zn, 5 t/ha FYM, and one spray of nano urea (T_6), followed by the T_8 treatment of 100% RDF, 30 kg S, 5 kg Zn, and 5 t/ha FYM, which also recorded significantly higher harvest index compared to the other treatments. The control treatment exhibited the minimum harvest index (26.06%). The higher harvest index in T_5, T_6, and T_7 could be attributed to the increased seed and stover yield achieved through INM.

The maximum nitrogen (56.57 kg/ha), phosphorus (6.85 kg/ha), potassium (42.82 kg/ha) and sulphur (11.59 kg/ha) uptake in plant (seed + stover) recorded in the treatment T_5 as compared to rest of all the treatments. Whereas, minimum nitrogen, phosphorus and potassium uptake in rapeseed plant (seed + stover) was recorded in the treatment control. This may be attributed to higher amount of NPK application, which increase the nitrogen content and uptake and also have positive effect on the phosphorus and potassium content in seed and stover. The increased nutrient uptake in the organic manure treated plots could be attributed to the additional nutrients provided by these organics, as well as the organics providing a conductive physical environment that facilitated better root growth and absorption of nutrients from both native and applied sources, which ultimately favoured the highest nutrient uptake. Plant nutrients, particularly nitrogen, phosphorus, potassium and sulphur must be given in a balanced manner. It could be linked to a healthy root system that efficiently aids

Table 2. Effect of INM on total nitrogen, phosphorus, potassium and sulphur uptake

Treatments*	Total nitrogen uptake (kg/ha)	Total phosphorus uptake (kg/ha)	Total potassium uptake (kg/ha)	Total sulphur uptake (kg/ha)
T_1	23.55	2.71	17.66	3.41
T_2	37.56	4.30	30.22	5.97
T_3	29.56	3.37	22.83	4.43
T_4	33.44	3.87	25.55	5.02
T_5	56.57	6.85	42.82	11.59
T_6	47.86	5.67	37.48	9.33
T_7	41.32	4.82	33.34	7.43
T_8	44.06	5.20	35.46	8.54
SEm±	1.41	0.17	1.51	0.34
CD (P=0.05)	4.34	0.54	4.63	1.08

*Treatment details are given under materials and methods section

in greater nutrient absorption from the soil, resulting in increased biomass and nutrient concentration, and therefore higher nutrient uptake. This finding is consistent with the studies conducted by Meena *et al*. (2022).

Thus, it can be concluded that application of 75% RDF + 22.5 kg S + 3.7 kg Zn + 2.5 t/ha FYM+ two spray of nano urea enhance the growth, yield and nutrient uptake of rapeseed under guava based agri- horti system.

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