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Effect of Zinc and FYM on growth and yield of mustard (*Brassica juncea* L.)

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Abstract
The present investigation entitled "Effect of Zn and FYM application on soil properties and performance of mustard crop (*Brassica juncea* L.)''Involved field experimentation conducted during Rabi season of year 2017-18. There are six treatments with three replication are T_1 (Control), T_2 (RDF+5kgZnha^{-1}), T_3 (RDF+5kgZn ha^{-1}+10tFYMha^{-1}) T_4 (RDF+10kgZnha^{-1}), T_5 (RDF+10kg Zn ha^{-1}+10tFYMha^{-1}), T_6 (RDF+15kgZn ha^{-1}), T_7 (RDF+15kgZn ha^{-1}+10tFYMha^{-1}). The recommended dose of fertilizers is 60kg N ha^{-1}, 40kgP2O5 ha^{-1}, 40kgK2O ha^{-1}. The growth attribute like plant height (181.80), number of branch plant (15.73) number of siliqua plant^{-1} (48.53) number of grains siliqua^{-1} (17.33) are higher in the treatment T_7 RDF+15kgZn ha^{-1}+10tFYMha^{-1}. The highest grain and straw yield was obtained by T_7 RDF+15kgZn ha^{-1}+10tFYMha^{-1} *i.e.* 5.25 qha^{-1} and 23.68 qha^{-1}. The treatment RDF+15kgZn ha^{-1}+10tFYMha^{-1} is far better than any other treatments.

Keywords: Zinc and FYM, yield of mustard

Introduction
Mustard plays important role in oilseed economy of India and ranks second in terms of area sown and production next to groundnut. The oil content varies from 37-49%. It is considered to have high tolerance to salts and water requirement of this crop is also low and it can be a good oilseed crop for arid and semi-arid tracts, where water is a very scarce commodity. Among the vegetable oils, mustard oil is one of the major single sources of essential fatty acids particularly in northern Indian diet. Mustard seed is primarily used as a source of edible oil and protein meal while, it is also used as a condiment. The seeds when crushed yield around 33% oil and 67% protein meal. The seed and oil used as condiment in the preparation of pickles and for flavouring curries and vegetables.

Zinc is one of the most important micronutrients for plant life. It is involved in most of plant metabolic functions like Zinc production of auxin. Apart from that Zinc involved to control the development of the shoot. It also plays a significant role in various enzymatic and physiological activities of the plant system.

The productivity is quite lower due to sub-optimal application of fertilizers and cultivation on marginal lands under rainfed conditions. Further the quality of mustard oil and its cake is an important aspect affected greatly by mineral nutrition. Intensive cultivation and use of unbalanced and inadequate fertilizers accompanied by restricted use of organic manures have made the soils not only deficient in the nutrients, but also deteriorated the soil health resulting in decline in crop response to the recommended dose of NPK fertilizers in the region. In order to bring the soil well supplied with all the essential plant nutrients and also to maintain it in good health, it is necessary to use organic source like farmyard manure, vermicompost, neemcake and poultry manure are good source of nutrients required by plants for quality produce.

Farmyard manure (FYM) helps in maintaining soil sustainability in terms of nutrients supply capacity of the soil. The increase in productivity of the crops might be attributed due to its essential role of all nutrients present in FYM for plant growth through its effect as a good source of soil organic matter which improves the physicochemical and biological properties of soil. Application of FYM also increases cation exchange capacity and buffering capacity of

soil which helps in keeping soil micronutrients in available form through its chelating action as well as microbial activity in soil besides supplying macro and micro plant nutrients.

Adoption of integrated plant nutrient supply and management strategies for enhancing soil quality, input use efficiency and crop productivity is extremely important for food and nutritional security in Indian agriculture (Swarup, 2010) [7]. Use of chemical fertilizers in combination with organic manure is essentially required to improve the soil health (Prasad *et al*. 2010) [4]. Chemical fertilizers/organic manures alone cannot sustain the desired levels of crop production under continuous farming.

Integrated nutrient management is very essential which is not only sustains high crop production over the years (Verma *et al.* 2010) [9] but also improves soil health and ensures safer environment (Vijaya Sankar Babu *et al.* 2007) [10]. The nutrient supplied to crops through IPNM not only restoring the soil fertility but also sustain desired level of production over the years (Pal and Pathak, 2016) [3]. Integrated use of NPK and FYM significantly improved the organic carbon and available NP K Zn contents over the chemical fertilizers alone. Integrated nutrient management with 100% N P K +10 t FYM ha^{-1} resulted in maximum yields and improved the soil fertility (Chesti *et al.* 2015) [1].

Materials and Methods

The present investigation entitled "Effect of Zinc and FYM on growth and yield of mustard *(Brassica juncea L)*'' Involved field experimentation conducted during Rabi season of year 2017-18 The field experiment was conducted during Rabi season 2017 on research plot of Udai Pratap Autonomous College, Varanasi (U.P.) adjoining the department of Agricultural Chemistry and Soil Science. The soils of Varanasi formed on alluvial, deposited by river Ganga have predominance of Illite, quartz, feldspars and Illite minerals are partly inherited from micas which are predominant in the sand and silt fractions. The period from November to February is generally cool and dry. The summer season from March to third week of June is hot and dry. The distribution of average annual rain fall is 96.65mm of which 80%from June to September, 5.7% from October to December, 3.3% from January to February and 0% from march to May. pH 7.26 EC 0.22dSm^{-1} OC 0.39% Available Nitrogen Kg ha^{-1} 256.58 Available phosphorus Kg ha^{-1} 13.0 Available potassium Kg ha^{-1} 280.59 Available sulphur Kg ha^{-1} 15.0

Result and Discussion

Growth Attributes

Plant height increased with increasing the levels of NPKZn and FYM. Maximum plant height was recorded with T_7 treatment as compared to other treatment at all growth stages. The effect of different doses of NPK +Zinc +FYM different growth stages of mustard crop was found in the order of $T_7>T_5>T_3>T_6>T_4>T_2>T_1$and values were 42.22, 40.83, 40.64, 38.93, 36.43, 33.97, 31.36 cm at 30DAS, and 87.66, 83.00, 82.10, 78.27, 77.16, 74.86, 68.06 cm at 60 DAS and 181.80, 177.28, 164.70, 161.28, 157.72, 151.86, 139.24 cm at 90 DAS under the respective treatment. Maximum plant height was recorded with the application NPK+Zinc+10t FYM i.e. T_7 might be due to balance nutrition under the favorable environment. These results show similarity with Reddy and Reddy (1998) [10]. Number of branch $plant^{-1}$ for all the treatments could be arranged in the order of $T_7>T_5>T_3>T_6>T_4>T_2>T_1$.Application of NPKZn + 10tFYM ha^{-1} i.e. T_7significantly increased to other treatments at all growth stage. Significantly higher number of branch was found with application of NPKs and FYM might be attracted to higher and continuous supply of NPKS. Similar results were also reported.

The effect of different dose of NPKZn and FYM on number of grains $siliqua^{-1}$was found in order $T_7>T_5>T_3>T_6>T_4>T_2>T_1$ and values were observed as 17.33, 16.00, 13.66, 8.66, 8.33, 10.00, and 6.00 under respective treatments. Maximum number of grains $siliqua^{-1}$recorded with T_7 as compared to other treatments. Similarly results were reported similarly the higher grain $siliqua^{-1}$ was recorded with application of NPK Zinc sulphate+10tFYM ha^{-1}.

The effect of various treatment on number of $siliquaplant^{-1}$ could be arranged in the order of $T_7>T_5>T_3>T_6>T_4>T_2>T_1$and value varies are 48.53, 45.73, 44.00, 41.76, 42.06, 40.33 and 39.30under the respective treatment. Significantly higher number of $siliquaplant^{-1}$was recorded with the application of NPK+Zn+10tFYM ha^{-1}i.e. T_7. The combination of FYM and inorganic fertilizers increased the number of siliqua $plant^{-1}$ than use of inorganic fertilizer alone. This might be due to combination of inorganic and organic fertilizers which improved the soil physical properties, which provide health and favourable soil condition to enhance nutrient efficiency. These results are in conformity.

Grain and Straw Yield

The grain yield of mustard crop could be arranged in order to $T_7>T_5>T_3>T_6>T_4>T_2>T_1$ and value were observed as 5.25, 4.76, 4.56, 3.43, 3.76, 3.33, and 2.85 q ha^{-1}under the respective treatment. This might be due to NPKZn and FYM application coupled with transport of photosynthesis toward reproductive structure might have increased the yield attributes. These results are conformity with those of Rjkhowa *et al.* (2000). Integration of FYM and NPKS recorded significantly higher grain yield over chemical fertilizer alone at all level of at all level of NPK Zn might be attributed to increased fertility status of soil and more availability of nutrient to the plant.

The straw yield of mustard crop could be arranged in order to $T_7>T_5>T_3>T_6>T_4>T_2>T_1$ and value were observed as 23.683, 20.650, 17.830, 13.766, 12.480, 11.410, 5.016 q ha^{-1} under respective treatments. Maximum straw yield were recorded under NPK+ Zn +10tFYM ha^{-1}i.e. T_7**.** The finding of present investigation are also supported.

Table 1: Effect of Zinc and FYM on growth attributes of mustard *(Brassica juncea L).*

Treatments	Plant height	Number of branch plant-1	Number of siliqua plant-1	Number of grains siliqua-1
T1 Control	139.24	4.06	39.30	6.00
T2 RDF+5kgZnha-1	151.86	4.53	40.33	10.00
T3 RDF+5kgZn ha-1+10tFYMha-1	164.70	4.96	44.00	13.66
T4 RDF+10kgZnha-1	157.72	4.43	42.06	8.33
T5 RDF+10kg Zn ha-1+10tFYMha-1	177.43	5.40	45.73	16.00
T6 RDF+15kgZn ha-1	161.28	4.63	41.76	8.66
T7 RDF+15kgZn ha-1+10tFYMha-1	181.80	5.73	48.53	17.33
SEm±	4.298	0.2507	0.6637	1.0672
CD (5%)	12.88	0.7516	1.989	3.1994

Table 2: Effect of Zinc and FYM on yield of mustard *(Brassica juncea L).*

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
T_1 Control	2.85	5.016
T_2 RDF+5kgZnha^{-1}	3.33	11.41
T_3 RDF+5kgZn ha^{-1}+10tFYMha^{-1}	4.56	17.83
T_4 RDF+10kgZnha^{-1}	3.76	12.48
T_5 RDF+10kg Zn ha^{-1}+10tFYMha^{-1}	4.76	20.65
T_6 RDF+15kgZn ha^{-1}	3.43	13.766
T_7 RDF+15kgZn ha^{-1}+10tFYMha^{-1}	5.25	23.683
SEm±	0.637	253.056
CD (5%)	1.911	258.66

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