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# Effect of Genotypes under Varying Fertility Levels and Bio-fertilizer Inoculation on productivity and profitability of Mustard {*Brassica juncea* (L.) Czern & Coss.}

***Preeti Devatwal[1*], Jagdish Choudhary[2], Kajal Arora[3], Devi Lal Kikraliya[4] and Anuj Kumar[5]***

*[1]Department of Agronomy, Agriculture University, Jodhpur (Rajasthan), India.*
*[2]Department of Agronomy, Maharana Pratap University of Agriculture Technology, Udaipur (Rajasthan), India.*
*[3]Department of Agronomy, Indian Agriculture Research Institute (New Delhi), India.*
*[4]Department of Agronomy, Swami Keshwanand Rajasthan Agriculture University (Rajasthan), India.*
*[5]Department of Agronomy, Agriculture University, Kota, (Rajasthan), India.*

*(Corresponding author: Preeti Devatwal*)*
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**ABSTRACT: A field experiment was carried out at Instructional Farm of Agronomy, Rajasthan College of Agriculture, Udaipur during October, 2020-2021 in humid and sub humid condition of Rajasthan. The experiment was laid out in the Factorial Randomized Block Design with three replications and consist of two factors. The first factor including four genotypes of mustard *i.e.* 'Bio-902', 'Giriraj', 'RH-0749' and 'NRCHB-101' and second factor was four fertility levels *i.e.* 75% RDF, 100% RDF, 75% RDF + Bio-fertilizer and 100% RDF + Bio-fertilizer. On the basis of performance highest seed, straw, biological yield, harvest index, and yield attributing characters *i.e.* primary, secondary, tertiary branches/plant, siliqua/plant, seed/siliqua and 1000 test weight exhibited by genotype 'Giriraj' and fertility levels. Further, among the various fertility levels maximum yield and yield attributes were significantly obtained under 100% RDF + Bio-fertilizer which was superior over rest of the treatments. However, significantly higher values of all the yield and yield attributing characters of mustard were observed with genotypes 'Giriraj' followed by 'NRCHB-101', 'Bio-902' and 'RH-0749' and fertility level 100% RDF + Bio-fertilizer as compare to other treatments. Relative economic analysis for crop cultivation indicated that the maximum gross return (₹/ha 103762, 97238), net return (₹/ha 83347, 77148) and benefit-cost ratio (4.09, 3.84) was found with Indian mustard variety 'Giriraj' with application of 100% RDF+ Bio-fertilizer. Challenges to instability in yield and production because of appropriate donor source for major biotic stresses like alternaria blight, white rust, aphid pest attack, and abiotic stresses like drought, frost, salinity. Indigenous sources with rich quality of oil and seed meal are available but are poor yielders. Hence, genotype Giriraj with the application of 100% RDF + Bio-fertilizer were proved economically viable in mustard crop under prevailing agro-climatic conditions of Rajasthan. A big challenges in mustard is disease infestation sclerotina rot, orobanchae parasite, alternaria blight disease, non availability of quality seed, painted bug were identified and their management require the on farm technology.**

**Keywords:** Yield, Yield attributes, Biofertilizer, Net return, Mustard genotypes, Economics.

## INTRODUCTION

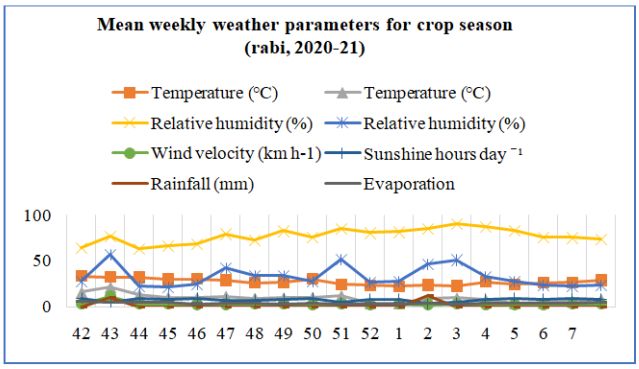
Mustard is the second important edible oilseed crop after soybean. Oilseeds play a vital role in Indian economy (Prasad, 2015) and known by the name of Indian mustard, belongs to the family *Brassiceae* (Cruciferae), genus *Brassica* and species *juncea*. Rapeseed is locally known as sarson, toria, yellow toria while mustard is named 'rai' or 'laha'. Mustard is a winter (*Rabi*) season crop which requires low temperature, proper soil moisture during entire crop growth period and dry condition during harvest (Budzynski and Jankowski 2019). The quality characteristics *viz*., oil, protein, glucosinolate content and fatty acids. Oil content of its seeds ranges from 38-46 % and possess adequate amount of erucic acid (40-60%) with linolenic up to 4.5 - 13 %. Mustard oil is good for human consumption and good for health because of rich source of the unsaturated fatty acids (Brar *et al*., 2016). At global level, India first position in area and second in production of mustard. Rapeseed-mustard crop occupies an area of 6.23 million ha in India with production and productivity of 9.34 million tonnes and 1499 kg/ha, respectively Government of India, 2019-20. Rajasthan and Uttar Pradesh are the major rapeseed and mustard growing states in the country. Rajasthan occupies 2.72 million ha area, 3.40 million tonnes production and 1558 kg/ha productivity (Economic survey, 2019). Among states, Bharatpur and Eastern districts are contributing about 48 % of the total production of mustard. Among the various oil seeds, rapeseed and mustard (*Brassica* sp.) crops stand next to soybean in terms of area and production and first in terms of vegetable oil supply in India (Kumar *et al*.,

2017). The young leaves of mustard are used as green vegetables, as they supply sulphur and minerals in the diet (Singh *et al*., 2012). Bio-fertilizers play an important role in the improvement of soil biological, physical and chemical properties. The use of bio fertilizers is also important to reduce the pollution rate in the soil and water. It's not only fixes the biological nitrogen but also solubilizes the insoluble phosphates in soil and thus improves fertilizer use efficiency. Biofertilizers also promote seed germination and give initial vigour of plant by producing growth promoting substances (Yadav *et al*., 2010). Sulphur is the fourth most important nutrient after nitrogen, phosphorus and zinc for Indian agriculture (Tandon and Messick 2005). It is best known for its role in the synthesis of proteins, oils, vitamins and flavoured compounds in plants. Three amino acids viz. Methionine (21%S), Cysteine (26%S), and Cystine (27%S) contain sulphur which are the building blocks of proteins. About 90% of sulphur is present in these amino acids (Chattopadhyay and Ghosh 2012). Sulphur application also has marked effect on soil properties and is used as soil amendment such as gypsum and pyrite to improve the availability of other nutrients in soil (Vermaand Dawson 2019). Adequate sulphur is therefore very much crucial for oil seed crops. Sulphur is also a constituent of vitamins biotine and thiamine ($B_1$) and also of iron sulphur proteins called ferrodoxins.

Phosphorus is a constituent of several essential cell components like nucleotides, nucleic acids and phospholipids which promotes root development of the crop Approximately 15-20 per cent of applied fertilizer phosphorus is utilized by the crops and rest of the gets fixed in the soil and becoming unavailable to crop plants (Toro, 2007). Thus, availability of phosphorus is the major problems in productivity of crops concerning not only its actual deficiency in soil but also its availability to crop plants. Variety selection is the most important decision to achieve higher crop yield by improving the fertilizer use efficiency and water use efficiency (Lal *et al*., 2020). It is well documented that the growth response and performance of various genotypes vary with the climate and soil factors and hence selection of suitable cultivars to a particular environmental condition helps in realizing the maximum production potential of a cultivar and thereby increasing the productivity Meena *et al*. (2020). Further, decomposition of organics in the soil leads to different types of biological reactions which are helpful in preventing various disease causing pathogens (Ramesh *et al*., 2010).

## MATERIALS AND METHODS

A field investigation was performed in mustard during October 2020-2021 at the Instructional Farm of Agronomy, Rajasthan College of Agriculture, Udaipur. The region falls under NARP agro-climatic zone IV a (Sub- Humid Southern Plain and Aravalli Hills) of Rajasthan, India. The site is situated at South-Eastern part of Rajasthan at an altitude of 581.13 m above mean sea level, 24°35′N latitude and 73°42′E longitude. The average rainfall of the region is 627.8 mm, most of which is mainly contributed by south west monsoon from June to September. The textural classes of the experimental soil was a clay loam in texture and slightly alkaline in reaction (pH 7.9), calcareous in nature and poor in organic carbon (0.69%). The total available N, $P_2O_5$ and $K_2O$ were 282.3, 21.5 and 294.7 kg/ha, respectively (Table 1). The treatments were laid out in Factorial Randomized Block Design with three replications. The experiment consisted of four genotypes *i.e.* 'Bio-902', 'Giriraj', 'RH-0749' and 'NRCHB-101' and various fertility levels *i.e.* 75% RDF, 100% RDF, 75% RDF + Bio-fertilizer and 100% RDF + Bio-fertilizer. However, the recommended dose of fertilizer was applied as per treatment needs through Urea, DAP. Half dose of nitrogen and full dose phosphorus with Bio-fertilizer (PSB and *Azotobactor*) was applied at the time of sowing and remaining half dose of nitrogen was applied in two equal splits at branching and flowering.




Mustard crop were raised with the seed rate of 5.0 kg/ha with the spacing of 30 cm × 10 cm. Sowing of seeds was done by hand broadcasting method with furrow and cover the soil to ensure moisture loss through evaporation. Plant geometry were maintained by doing thinning and weeding operation at 15 DAS and 25 DAS respectively. Hence, all the other cultural operations were carried out as per the treatment needs. However, two irrigation were given at peak vegetative stage and pod filling stage to maintain optimum soil moisture for better growth & development of mustard and one last irrigation at maturity stage. Finally, plant protection measures were also done to protect the crop from mustard aphid with the application of spray of Imidacloprid 17.8% at 60 DAS at pod formation stage.

**Effect of varieties and fertility levels on mustard.**

## RESULTS AND DISCUSSIONS

On the basis of mean performance of yield and yield contributing characters genotype 'Giriraj' was highest yielder followed by 'NRCHB 101', 'Bio 902' and 'RH 0749'.

**Effect on yield attributes.** On the basis of performance the higher value of yield attributes *i.e.* primary, secondary, tertiary branches, Siliqua/plant, Seeds/siliqua and 1000 seed weight were recorded significantly higher under the genotype 'Giriraj' (5.61, 10.88, 3.35, 334.74, 15.01, 5.64) followed by 'NRCHB-101' (5.45, 10.64, 3.06, 310.07, 13.95, 5.61), 'Bio-902' (4.94, 10.28, 3.20, 271.53, 11.75, 5.00) and 'RH-0749' (4.60, 10.20, 2.03, 250.81, 11.50, 5.06) (Fig. 1 & 2). But primary branches, tertiary branches and 1000 seed weight which were statistically at par with 'NRCHB-101', 'Bio-902' and 'NRCHB-101' respectively. The magnitude increased in respect of seeds/siliqua in 'Giriraj' was 27.74, 30.52 and 7.5 %, respectively. Enhancement of yield attributes might be due to the differential genetic potential of the genotypes which showed greater photosynthetic efficiency and it translocation to growing points which results faster growth and development results are similarly found with Pachauri *et al*. (2012).

**Effect on Yield**

**Seed, straw and biological yield**

Analysis of the data pertaining to seed, straw and biological yield were significantly observed under genotype 'Giriraj' compare to other genotypes. Genotype 'Giriraj' recorded seed yield1812 kg/ha followed by 'NRCHB-101' (1557kg/ha), Bio-902 (1380 kg/ha) (Table 2). The minimum seed yield was recorded with genotype 'RH-0749' (1221 kg/ha). Genotype 'Giriraj' was enhanced seed yield by means of 31.30, 48.31 and 16.36 %, respectively. The maximum straw and biological yield were also significantly obtained under genotype 'Giriraj' (5123 kg/ha and 6935 kg/ha). The magnitude of increased by means of 31.74, 50.05 and 16.81 % in straw yield and 31.62, 49.59 and 16.69 % in biological yield over Bio-902 (3889kg/ha and 5269kg/ha), RH-0749 (3414 kg/ha and 4636 kg/ha) and NRCHB 101 (4386 kg/ha and 5943 kg/ha), respectively. Yield variations amongst mustard genotypes might be due to different genetic makeup (Solanki *et al*., 2015). Higher seed and straw yield of 'Giriraj' genotype due to this aggressive growth attributes, better source and sink relationship which ultimately results in high yield. Our results are closely similar with findings of Kumar *et al*. (2000).

Fertility levels were influenced on seed, straw and biological yield. The maximum seed, straw and biological yield were significantly observed under 100% RDF + Bio-fertilizer compare to other fertility levels. 100% RDF + Bio-fertilizer observed 1694 kg/ha followed by 100% RDF (1517), 75 % RDF + Bio-fertilizer kg/ha (1501 kg/ha). The minimum seed yield was recorded with 75 % RDF (1258 kg/ha). The magnitude increase of seed yield by means of 34.60, 11.68 and 12.86 %, respectively. The maximum straw and biological yield were also significantly obtained under 100% RDF + Bio-fertilizer (5065 kg/ha and 6759 kg/ha). 100% RDF + Bio-fertilizer (5065 kg/ha and 6759 kg/ha) was enhanced straw yield and biological yield by means of 57.17, 18.45 and 18.64 % and 51.45, 16.67 and 17.14 %, respectively over 100% RDF (4276 kg/ha and 5793 kg/ha) and 75 % RDF + Bio-fertilizer (4269 kg/ha and 5770 kg/ha) and 75 % RDF (3204 kg/ha and kg/ha 4462). Application of 100% RDF + Bio-fertilizer increase in overall yield might be due to tissue differentiation from somatic to reproductive, meristematic activity and development of floral primordial. Higher fertility levels induced greater translocation of photosynthates from leaves to sink site accordance with the findings of Bhari *et al*. (2000); Prem and Kumar (2004). Similarly, results are found nitrogen application showed substantial increase in seed and straw yield of mustard by (Singh and Verma 2007). The balanced fertilization of mustard crop may be responsible to the effect of N on root proliferation, energy transformation and metabolic activities of the plant, which in term resulted in greater translocation of photosynthates towards the sink development finely yield increased Dongarkar *et al*. (2005).

**Effect on Economics.** The maximum gross return, net return and B-C ratio (103762 ₹/ha, 83347 ₹/ha and 4.09) were obtained under genotype 'Giriraj' which was significantly higher over 'NRCHB-101' (89154 ₹/ha 68739 ₹/ha and 3.37), 'Bio-902' (79016 ₹/ha, 58601 ₹/ha and 2.88) and 'RH-0749' (69930 ₹/ha, 49515 and 2.43). Increment in economics due to increased seed and biological yield of mustard.

Fertility levels influenced on profitability with different level of fertilizers. The maximum gross return (97238 ₹/ha) net return (77148 ₹/ha) and B-Cratio (3.84) were observed under 100 % RDF + Bio-fertilizer which was significantly higher over 100% RDF (86856 ₹/ha 66826 ₹/ha and 3.34), 75 % RDF + Bio-fertilizer (85979 ₹/ha 65179 ₹/ha and 3.13) and 75 % RDF (71790 ₹/ha 51050 ₹/ha and 2.46) (Table 3). The increment in economics might be due to application of phosphorus and potassium found higher monetary returns with increasing fertility levels as comparatively lower fertility. The similar results observed by Daulagupu and Thakuria (2016); Jat *et al*. (2017).

**Table 1: Physico-chemical properties of the experimental soil at Udaipur (Rajasthan).**

| Sr. No. | Parameters | Status/Value | Methods of Employed |
|---|---|---|---|
| 1. | Textural classes | Cay loam | Triangular diagram (Brady and Well 1983 |
| 2. | Soil reaction (pH) | 7.9 | pH meter (Richards, 1968) |
| 3. | Organic carbon (%) | 0.69 | Rapid titration method (Walkley and Black 1947) |
| 4. | Available N (kg/ha) | 282.3 | Alkaline $KMnO_4$ method (Subbian and Asija, 1956) |
| 5. | Available $P_2O_5$ (kg/ha) | 21.5 | Olsen's method (Olsen *et al.*, 1954) |
| 6. | Available $K_2O$ (kg/ha) | 294.7 | Flame photometer (Richards, 1968) |

**Table 2: Effect of genotypes and fertility levels on yield of mustard.**

| Treatments | Yield | | | | Harvest index (%) |
|---|---|---|---|---|---|
| | Seed yield (g/plant) | Seed yield (kg/ ha) | Straw yield (kg/ha) | Biological yield (kg/ha) | |
| **Mustard genotypes** | | | | | |
| Bio 902 | 5.12 | 1380 | 3889 | 5269 | 26.77 |
| Giriraj | 5.71 | 1812 | 5123 | 6935 | 26.26 |
| RH 0749 | 4.26 | 1221 | 3414 | 4636 | 26.55 |
| NRCHB 101 | 5.40 | 1557 | 4386 | 5943 | 26.36 |
| SEm± | 0.11 | 39.77 | 116.22 | 133.02 | 0.77 |
| C.D. (P=0.05) | 0.33 | 114.87 | 335.65 | 384.19 | NS |
| Fertility levels | | | | | |
| 75 % RDF | 4.86 | 1258 | 3204 | 4462 | 28.68 |
| 100% RDF | 5.09 | 1517 | 4276 | 5793 | 26.21 |
| 75 % RDF + Biofertilizer | 5.05 | 1501 | 4269 | 5770 | 26.06 |
| 100% RDF + Biofertilizer | 5.49 | 1694 | 5065 | 6759 | 25.01 |
| SEm± | 0.11 | 39.77 | 116.22 | 133.02 | 0.77 |
| C.D. (*P<0.05) | 0.33 | 114.87 | 335.65 | 384.19 | 2.24 |

**Table 3: Effect of genotypes and fertility levels on economics.**

| Treatments | Economics | | |
|---|---|---|---|
| | Gross return (₹/ha) | Net return (₹/ha) | B-C ratio |
| **Mustard genotypes** | | | |
| Bio 902 | 79016 | 58601 | 2.88 |
| Giriraj | 103762 | 83347 | 4.09 |
| RH 0749 | 69930 | 49515 | 2.43 |
| NRCHB 101 | 89154 | 68739 | 3.37 |
| SEm± | 2215 | 2215 | 0.11 |
| C.D. (P=0.05) | 6398 | 6398 | 0.32 |
| Fertility levels | | | |
| 75 % RDF | 71790 | 51050 | 2.46 |
| 100% RDF | 86856 | 66826 | 3.34 |
| 75 % RDF + Biofertilizer | 85979 | 65179 | 3.13 |
| 100% RDF + Biofertilizer | 97238 | 77148 | 3.84 |
| SEm± | 2215 | 2215 | 0.11 |
| C.D. (*P<0.05) | 6398 | 6398 | 0.32 |

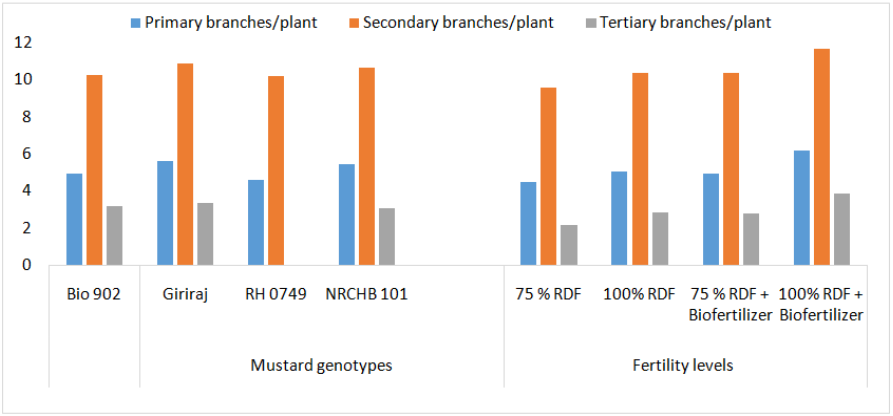



**Fig. 1.** Effect of genotypes and fertility levels on primary, secondary and tertiary branches/plant.

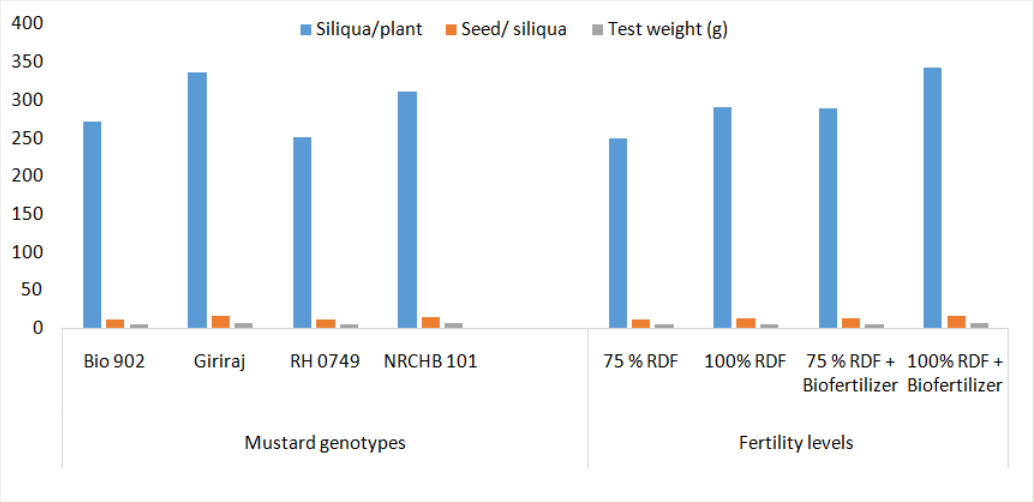



**Fig. 2.** Effect of genotypes and fertility levels on siliqua/plant, seed/siliqua and test weight.

## CONCLUSIONS

The results of the investigation maximum seed yield (1812 kg/ha), gross return (₹ 103762 /ha), net return (₹ 83347 /ha) and B-C ratio (4.09) was obtained with genotype Giriraj further, maximum seed yield, gross return, net return and B-C ratio was realized under application of 100 % RDF + Bio-fertilizer compared to other fertility levels. Hence, genotype Giriraj with the application of 100% RDF + Bio-fertilizer were proved economically viable in mustard crop under prevailing agro-climatic conditions of Rajasthan.

## FUTURE SCOPE

I would like to draw my views for future guidance related to my research work which i did on mustard crop. Farmers should grow multiple varieties with biofetilizer like Bio 902, Giriraj, RH 749 and NRCHB 101 that will produced higher yield in water deficit condition and it will be beneficial for farmers. Because water requirement of the mustard crop is low so it's better adapted in arid and semi-arid condition of the Rajasthan.

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**Conflict of Interest.** None.

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