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Effect of mycorrhiza and foliar fertilization on available nutrient content and dehydrogenase activity in soil under arid region

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Abstract
A field experiment was conducted for two consecutive *Rabi* seasons of 2021-22 and 2022-23 at Instructional Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner to study the influence of mycorrhiza and foliar fertilization on available nutrient content and dehydrogenase activity in soil under arid region. The experiment was laid out in factorial randomized block design with twenty four treatment combinations replicated thrice. The results revealed that application of 100% RDF, mycorrhiza @ 8 kg ha^{-1} and foliar spray with 0.3% nano urea + 0.2% liquid sulphur fertilizer significantly altered the nutrient content and dehydrogenase activity in soil.

Keywords: Available nutrient content and dehydrogenase activity

Introduction
Mustard (*Brassica juncea* L.) is the second most important oil seed crop after groundnut in India. The oil content in mustard varies from 38-42%. The oil is utilized for human consumption throughout the northern India for cooking purposes. It is also used in preparation of hair oils, medicines and greases. Oil cake is used as feed and manure. Green stem and leaves are a good source of green fodder for cattle. Mustard seed is used as a condiment in the preparation of pickles and for flavouring curries and vegetables. In India, Rajasthan is the largest producer of rapeseed-mustard, followed by Madhya Pradesh, Haryana, Uttar Pradesh, West Bengal, Gujarat and Assam.

Mycorrhiza association is a symbiotic non-pathogenic association between plant roots and fungal hyphae with a fungal relation between soil and the root. Vesicular Carbuncular Mycorrhizas (VAMs) can supply as high as 80% of P and 25% of N needed by its symbiotic partner. The significance of mycorrhiza association in both agricultural and ecological systems has been widely recognised. The notable positive impacts of VAM on plant yields should be added many other advantages such as a greater survival rate of colonized plants, preservation of plant biodiversity, improvement of soil micro flora (Boer *et al*., 2005) [2], protection from biotic and abiotic environmental stresses (Evelin *et al.*, 2009; Neumann and George, 2009) [3, 6], the improvement of soil structure and the decreased pesticide use (Strack *et al*., 2003) [11]. Rathore *et al.* (2015) [9] stated that the sulphur (S) is a crucial element for rapeseed-mustard in enhancing its seed yield, oil content and quality. Besides promoting chlorophyll formation and oil synthesis, it is an important constituent of seed protein, amino acids, various enzymes, and glucosinolates. Nano fertilizers (NFs) have introduced recently in India and are important in increasing the efficiency of resources used for crop production including nutrients, water, energy etc. It gives higher yield, better quality, reduces soil contamination and it is also safer to the environment.

Material and Methods
A field experiment was conducted for two consecutive *Rabi* seasons of 2021-22 and 2022-23 to study the influence of mycorrhiza and foliar fertilization on available nutrient content and dehydrogenase activity in soil under arid region at Instructional Farm, College of Agriculture, Swami Keshwan and Rajasthan Agricultural University, Bikaner (28° 10' N, 73° 35' E and at an altitude of 235 meters above mean sea level). The soil was loamy sand in texture and slightly alkaline in reaction.

The experiment consisted of twenty four treatment combinations comprising of two levels of chemical fertilizers (100% and 75% RDF), two levels of mycorrhiza (control and mycorrhiza @ 8 kg ha^{-1}) and six levels of foliar fertilization (control, foliar spray of 0.3% nano urea, 1% MAP, 1% NPK, 1% NPK + 0.2% liquid sulphur fertilizer and 0.3% nano urea + 0.2% liquid sulphur fertilizer). The recommended dose of nitrogen was applied in two equal splits, the half as basal and the remaining half as top dressing at the time of first irrigation. The basal dose was applied through urea after adjusting the nitrogen quantity supply through ammonium phosphate. The whole quantity of phosphorus through ammonium phosphate, potassium through muriate of potash and sulphur through betonies sulphur were drilled as basal dose at 7-10 cm depth along with half dose of nitrogen prior to sowing. The soil based granular mycorrhiza @ 8 kg ha^{-1} containing hyphae and spores was mixed with 8-10 kg vermicompost and applied to the soil at the time of sowing as per treatments in the allotted plots and incorporated well in soil of the plots before sowing. Three sprays of each treatment were done over the crop at 40, 60 and 80 days after sowing using 400 litters of water per hectare. The experimental data recorded were subjected to statistical analysis in accordance with the "Analysis of variance" technique suggested by Fisher (1936). The critical difference (CD) for the treatment comparisons were worked out wherever the variance ratio (F test) was found significant at 5% probability level.

Results and Discussion

Effect of fertilizer levels, mycorrhiza and foliar fertilization on nutrient content in soil

Application of 100% RDF significantly increased the available N, P, K and S content in soil after harvest of mustard during 2021-22, 2022-23 and on pooled basis (Table 1 and 2). Higher N, P, K and S content (136.07, 29.84, 168.22 and 20.81 kg ha^{-1}) was recorded with 100% RDF as compared to 75% RDF based on pooled mean, respectively. Significant increase in available nitrogen could be attributed to increase in activity of nitrogen fixing bacteria there by higher accumulation of nitrogen in soil (Parmer *et al.*, 1998) [7]. Further, phosphorus status of soil increased with increase in level of fertilizer due to limited utilization of applied P by crop which resulted in build-up of soil phosphorus (Sharma *et al.*, 2013) [10]. The ample quantity of potassium and sulphur could be attributed to the higher amount of potassium and sulphur being added through muriate of potash and betonies sulphur, respectively. Application of mycorrhiza @ 8 kg ha^{-1} and foliar spray with 0.3% nano urea + 0.2% liquid sulphur fertilizer had non-significant influence on available nutrient content in soil after harvest of mustard during 2021-22, 2022-23 and on pooled mean basis.

Effect of fertilizer levels, mycorrhiza and foliar fertilization on dehydrogenase activity in soil

Application of 100% RDF significantly improved the dehydrogenase activity in soil after harvest of mustard over 75% RDF during experimentation (Table 3). Maximum dehydrogenase activity was recorded with 100% RDF (55.92, 55.21 and 56.07 µg TPF g^{-1} soil 24 hr^{-1}) over 75% RDF (51.21, 52.45 and 51.83 µg TPF g^{-1} soil 24 hr^{-1}) during 2021-22, 2022-23 and on pooled mean basis, respectively. According to Masto *et al.*, (2006) [5] dehydrogenase enzyme activity was mainly depends upon addition of nutrient amount. The increased enzymatic activity with the increase in levels of fertilizer application might be due to the fact that inorganic sources of nutrients stimulated the activity of micro-organisms for utilizing the native pool of soil organic carbon which act as a substrate for these enzymes (Bhatt *et al.*, 2017). Application of mycorrhiza @ 8 kg ha^{-1} recorded maximum dehydrogenase activity in soil (55.32, 55.58 and 55.45 µg TPF g^{-1} soil 24 hr^{-1}) over control (51.81, 53.08 and 52.44 µg TPF g^{-1} soil 24 hr^{-1}) during 2021-22, 2022-23 and on pooled mean basis, respectively. The reason might be linked to that carbuncular mycorrhiza fungi (AMF) enhance the release of soil nutrients required for plant growth in response to increased soil enzyme activity (Quin *et al.*, 2019) [8].

Table 1: Effect of mycorrhiza and foliar fertilization on available nitrogen (N) and phosphorus (P) content in soil after harvest of mustard

Treatments	Available N (kg ha^{-1})			Available P (kg ha^{-1})		
	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
A. Fertilizer levels						
F_1 (100% RDF)	134.89	137.26	136.07	29.69	29.98	29.84
F_2 (75% RDF)	123.55	129.36	126.46	25.18	25.79	25.48
S.E.M±	2.00	1.92	1.39	0.44	0.54	0.35
CD (P=0.05)	5.69	5.48	3.90	1.24	1.54	0.98
B. Mycorrhiza						
M_0 (Control)	128.10	132.09	130.09	27.21	27.41	27.31
M_1 (Mycorrhiza @ 8 kg ha^{-1})	130.34	134.53	132.43	27.66	28.36	28.01
S.E.M±	2.00	1.92	1.39	0.44	0.54	0.35
CD (P=0.05)	NS	NS	NS	NS	NS	NS
C. Foliar fertilization						
S_0 (Control)	128.07	129.94	129.01	26.71	26.79	26.75
S_1 (Foliar spray of 0.3% nano urea)	129.96	137.18	133.57	27.12	27.68	27.40
S_2 (Foliar spray of 1% MAP)	125.79	132.64	129.22	26.77	27.27	27.02
S_3 (Foliar spray of 1% NPK)	128.32	134.91	131.62	27.07	27.47	27.27
S_4 (Foliar spray of 1% NPK + 0.2% liquid sulphur fertilizer)	130.95	132.16	131.55	28.36	28.81	28.58
S_5 (Foliar spray of 0.3% nano urea + 0.2% liquid sulphur fertilizer)	132.23	133.02	132.62	28.59	29.28	28.93
S.E.M±	3.46	3.33	2.40	0.76	0.94	0.60
CD (P=0.05)	NS	NS	NS	NS	NS	NS

Table 2: Effect of mycorrhiza and foliar fertilization on available potassium (K) and sulphur (S) content in soil after harvest of mustard

Treatments	Available K (kg ha^{-1})			Available S (kg ha^{-1})		
	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
A. Fertilizer levels						
F_1 (100% RDF)	164.71	171.72	168.22	19.98	21.63	20.81
F_2 (75% RDF)	157.13	162.93	160.03	17.58	19.49	18.54
S.E.M±	2.05	2.37	1.56	0.38	0.32	0.25
CD (P=0.05)	5.83	6.74	4.40	1.09	0.91	0.70
B. Mycorrhiza						
M_0 (Control)	159.38	165.81	162.60	18.46	20.17	19.31
M_1 (Mycorrhiza @ 8 kg ha^{-1})	162.45	168.84	165.65	19.10	20.96	20.03
S.E.M±	2.05	2.37	1.56	0.38	0.32	0.25
CD (P=0.05)	NS	NS	NS	NS	NS	NS
C. Foliar fertilization						
S_0 (Control)	154.85	160.65	157.75	18.31	19.99	19.15
S_1 (Foliar spray of 0.3% nano urea)	161.32	168.85	165.09	18.77	20.80	19.78
S_2 (Foliar spray of 1% MAP)	160.70	167.94	164.32	18.37	20.03	19.20
S_3 (Foliar spray of 1% NPK)	160.74	168.12	164.43	18.33	20.33	19.33
S_4 (Foliar spray of 1% NPK + 0.2% liquid sulphur fertilizer)	163.21	169.06	166.14	19.27	21.17	20.22
S_5 (Foliar spray of 0.3% nano urea + 0.2% liquid sulphur fertilizer)	164.69	169.32	167.00	19.63	21.06	20.34
S.E.M±	3.55	4.10	2.71	0.66	0.55	0.43
CD (P=0.05)	NS	NS	NS	NS	NS	NS

Table 3: Effect of mycorrhiza and foliar fertilization on dehydrogenase activity in soil after harvest of mustard

Treatments	Dehydrogenase activity (µg TPF g^{-1} soil 24 hr^{-1})		
	2021-22	2022-23	Pooled
A. Fertilizer levels			
F_1 (100% RDF)	55.92	56.21	56.07
F_2 (75% RDF)	51.21	52.45	51.83
S.E.M±	0.96	0.78	0.62
CD (P=0.05)	2.74	2.21	1.74
B. Mycorrhiza			
M_0 (Control)	51.81	53.08	52.44
M_1 (Mycorrhiza @ 8 kg ha^{-1})	55.32	55.58	55.45
S.E.M±	0.96	0.78	0.62
CD (P=0.05)	2.74	2.21	1.74
C. Foliar fertilization			
S_0 (Control)	51.55	51.73	51.64
S_1 (Foliar spray of 0.3% nano urea)	53.74	54.86	54.30
S_2 (Foliar spray of 1% MAP)	52.53	53.54	53.04
S_3 (Foliar spray of 1% NPK)	53.21	54.60	53.91
S_4 (Foliar spray of 1% NPK + 0.2% liquid sulphur fertilizer)	55.03	55.73	55.38
S_5 (Foliar spray of 0.3% nano urea + 0.2% liquid sulphur fertilizer)	55.33	55.52	55.42
S.E.M±	1.67	1.35	1.07
CD (P=0.05)	NS	NS	NS

Conclusion

Based on the results of two year experimentation, it may be inferred that application of 100% RDF and mycorrhiza @ 8 kg ha^{-1} significantly improved the available nutrient content and enhanced the dehydrogenase enzyme activity in soil.

References

1. Bhatt MK, Labanya R, Joshi HC, Pareek N, Chandra R, Raverkar KP. Long-term effects of inorganic fertilizers and FYM on soil chemical properties and yield of wheat under rice-wheat cropping system. Himalayan Ecology. 2017;25:28-35.
2. Boer WD, Folman LB, Summerbell RC, Boddy L. Living in a fungal world: impact of fungi on soil bacterial niche development. FEMS Microbiology Reviews. 2005;29(4):795-811.
3. Evelin H, Kapoor R, Giri B. Arbuscular mycorrhizal fungi in alleviation of salt stress. Annals of Botany. 2009;104:1263-1280.
4. Fisher RA. Statistical methods for research workers. Statistical methods for research workers, (6th Ed); c1936.
5. Masto RE, Chhonkar PK, Singh D, Patra AK. Changes in soil biological and biochemical characteristics in a long-term field trial on a sub tropical Inceptisol. Soil Biology and Biochemistry. 2006;38(7):1577-1582.
6. Neumann E, George E. The effect of arbuscular mycorrhizal root colonization on growth and nutrient uptake of two different cowpea (*Vigna unguiculata* L.) genotypes exposed to drought stress. Emirates Journal of Food and Agriculture. 2009;21:1-17.
7. Parmer DK, Sharma PK, Sharma TR. Integrated nutrient supply system for 'DPP68' vegetable pea (*Pisum sativum* var. *arvense*) in dry temperate zone of Himachal Pradesh. Indian Journal of Agricultural Sciences. 1998;68:84-86.
8. Qin M, Zhang Q, Pan J, Jiang S, Liu Y, Bahadur A, *et al.* Effect of arbuscular mycorrhizal fungi on soil enzyme activity is coupled with increased plant biomass. European Journal of Soil Science. 2019;71(1):84-92.

9. Rathore SS, Shekhawat K, Kandpal BK, Premi OP, Singh SP, Chand G. Sulphur management for increased productivity of Indian mustard: A review. Annals of Plant and Soil Research. 2015;17(1):1-12.
10. Sharma SB, Sayyed RZ, Trivedi MH, Gobi TA. Phosphate solubilizing microbes: sustainable approach for managing phosphorus deficiency in agricultural soils. Springer Plus. 2013;2:1-14.
11. Strack D, Fester T, Hause B, Schliemann W, Walter MH. Carbuncular mycorrhiza, biological, chemical and molecular aspects. Journal of Chemical Ecology. 2003;29:1955-1979.