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Correlation between soil nutrient and plant nutrient concentration in mustard

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Abstract
This study was carried out to evaluate the correlation between soil nutrients and plant nutrients at flowering stage in Gharsana tehsil of Sriganganagar district. Each nutrient content of mustard plant at flowering stage shown different positive and negative correlation between soil nutrients. Soil nutrients like Nitrogen, phosphorus, and potassium shown positive correlation between plant nutrients like Nitrogen, phosphorus, potassium, calcium, magnesium, iron, copper, and manganese, while, negative correlation with plant sulphur respectively. Zinc content of plant were positively correlated with soil Nitrogen and potassium but negatively correlate with phosphorus content of soil. Soil manganese were positively correlated with plant nutrients like Nitrogen, potassium, calcium, magnesium, sulphur, zinc, iron, copper, and manganese, while, negative correlated with phosphorus content of plant.

Keywords: Soil nutrients, Plant nutrients, Correlation

Introduction
Plant growth and development largely depend on the combination and concentration of mineral nutrients available in the soil. Plants often face significant challenges in obtaining an adequate supply of these nutrients to meet the demands of basic cellular processes due to their relative immobility. A deficiency of any one of them may result in decreased plant productivity and/or fertility. Symptoms of nutrient deficiency may include stunted growth, death of plant tissue, or yellowing of the leaves caused by a reduced production of chlorophyll, a pigment needed for photosynthesis. Nutrient deficiency can have a significant impact on agriculture, resulting in reduced crop yield or reduced plant quality. Nutrient deficiency can also lead to reduced overall biodiversity since plants serve as the producers that support most food webs. Two classes of nutrients are considered essential for plants: macronutrients and micronutrients. Macronutrients are the building blocks of crucial cellular components like proteins and nucleic acids; as the name suggests, they are required in large quantities. Nitrogen, phosphorus, magnesium, and potassium are some of the most important macronutrients. Micronutrients, including iron, zinc, manganese, and copper, are required in very small amounts. Micronutrients are often required as cofactors for enzyme activity. Mineral nutrients are usually obtained from the soil through plant roots, but many factors can affect the efficiency of nutrient acquisition. One of the most universal adaptations to nutrient-limited soils is a change in root structure that may increase the overall surface area of the root to increase nutrient acquisition or may increase elongation of the root system to access new nutrient sources. These changes can lead to an increase in the allocation of resources to overall root growth, thus resulting in greater root to shoot ratios in nutrient-limited plants (Lopez-Bucio *et al.*, 2003). In order to maintain nutrient homeostasis, plants must regulate nutrient uptake and must respond to changes in the soil as well as within the plant. Thus, plant species utilize various strategies for mobilization and uptake of nutrients as well as chelation, transport between the various cells and organs of the plant and storage to achieve whole-plant nutrient homeostasis. There for in the study, correlate the soil nutrient with plant composition.

Materials and methods
Gharsana tehsil is located in north-west part of the Sriganganagar district (Rajasthan) and situated between 29°02' north latitude and 73°05' east longitude and elevation of 156 m from mean sea level. The climate of the area is typically semi-arid. Rainfall and temperatures are the two main elements of the climate. The rainfall is seasonal and not properly distributed and it varies between 100 to 350 mm annually which is mostly received during the months of July to September. In summers maximum temperature ranges between 37^0C to 49^0C and in winters the minimum temperature varies from 1^0C to 10^0C and sometimes it falls below 0^0C.

Results and Discussion

Nutrient status of soil

The available nitrogen in soils varied from 54.10 to 160.10 kg ha^{-1}.

The phosphorus content of the soils ranged from 12.13 to 44.57 kg P_2O_5 ha^{-1} with a mean value 28.85 kg P_2O_5 ha^{-1}.The variation in available phosphorus appears to be due to marked variation in organic carbon, $CaCO_3$ and other soil characteristics.

The available potassium in soils ranged between 213.39 to 302.65 kg K_2O ha^{-1}. It might due to the presence of most of mica (biotite and muscovite both) in finer fraction (<0.002mm size).

The content of DTPA- Fe in soils of Gharsana tehsil of Siriganganagar district varied from 165 to 4.30 with the mean value of 2.65 ppm.

The amount of DTPA-Mn ranged between 5.37 to 5.90 ppm.

The content of Cu in these soils ranged from 0.02 to 0.27 ppm with a mean value of 0.05 ppm.

The DTPA extractable Zn content of the soil ranged from 0.20 to 0.59 ppm with a mean value of 0.36 ppm.

Nutrient content of plant at flowering stage

Nitrogen

In mustard plant nitrogen content ranged from 2.85 per cent to 3.81 per cent with a mean value of 3.32 per cent.

Phosphorus

In mustard plant phosphorus content also ranged from 0.52 per cent to 0.81 per cent with a mean value of 0.64 per cent.

Potassium

Potassium content in mustard plant also ranged from 2.13 per cent to 3.95 per cent with a mean value of 2.90 per cent.

Calcium

Calcium content in mustard crop varied from 0.20 to 0.40 per cent

Magnesium

In mustard plant magnesium content also ranged from 0.29 per cent to 0.48 per cent with a mean value of 0.38 per cent.

Sulphur

In mustard plant sulphur content also ranged from 0.32 per cent to 0.58 per cent with a mean value of 0.47 per cent.

Zinc

In leaves of mustard plant samples the Zn content ranged from 12.18 ppm to 15.50 ppm with an average value of 13.85 ppm.

Iron

The Fe content in mustard leaves ranged from 17.26 ppm to 27.58 ppm with an average value of 22.74 ppm.

Copper

Copper content in mustard leaves ranged from 4.52 ppm to 4.89 ppm with an average value of 4.58 ppm.

Manganese

In leaves of mustard plant samples the manganese content ranged from 14.38 ppm to 15.75 ppm with an average value of 14.99 ppm.

Relationship between soil nutrients and plant nutrients

Nitrogen

Nitrogen content in mustard plant has found non significant and positive correlation with N (r=0.031), P(r=0.014), K (r=0.073), Zn (r= 0.220), Fe (r= 0.099) and Mn (r= 0.077) of soils. An increase in N concentration with the application of N in Indian mustard has been reported (Kakati and Kalita, 1996) which was reflected in increased seed yield and yield attributing characters. The N also resulted in mobilization of P by 26 per cent increase into the leaf, respectively. The application of chemical fertilizers (100% N) along with FYM @ 10 t ha^{-1} had significantly improved the availability and uptake of micronutrients like Zinc by sorghum and wheat. Soil nitrogen also positive correlation with plant nutrient like Ca, Mg, S, Fe Cu and Mn in soil. Soil N is increased than uptake of plant micronutrient also increased (Sahay *et al.* 2005).

Phosphorus

In case of phosphorus content in mustard plant has found non significant and positive correlation with N (r=0.048), P(r=0.068), K (r=0.161), while, negative correlation with Zn (r= -0.066) of soils under mustard cultivation. Many workers have indicated that P uptake increases with increasing level of P in the soil (Randhawa *et al.*1973; Sinha, 1973).

Potassium

Potassium content in mustard plant has also found non significant and positive correlation with N (r=0.116), P(r=0.011), K (r=0.060), Cu (r=0.041) and Mn (r= 0.208) of soils under mustard cultivation. Present findings are in conformity by Nandapure *et al.* (2011) and Singh *et al.(*2011).

Calcium

Calcium content in mustard plant has also found non significant and positive correlation with N (r= 0.027), P(r= 0.007), K (r= 0.285), Fe (r= 0.110), Zn (r= 0.126), Cu (r= 0.140) and Mn (r= 0.064) of soils under mustard cultivation. Present findings are in conformity by Murphy *et al.* (2008), Nandapure *et al.* (2011).

Magnesium

In case of magnesium content in mustard plant has also found non significant and positive correlation with N (r=0.036), P(r=0.011), K (r=0.294), Fe (r= 0.086), Zn (r= 0.114), Cu (r= 0.127) and Mn (r= 0.100) of soils under mustard cultivation. Present findings are in conformity by Murphy *et al.* (2008), Nandapure *et al.* (2011).

Sulphur

In case of sulphur content in mustard plant has also found similar non significant and positive correlation with Fe (r= 0.066), Zn (r= 0.017), Cu (r=0.137) and Mn (r= 0.194), while negative correlation with N (r=-0.065), P(r=-0.015) and K (r=-0.168) of soils under mustard cultivation. Present findings are in conformity by Kotangale *et al.* (2009) and Singh *et al.* (2011).

Zinc

In case of mustard plant Zn content had shown non significant and positively correlation with N(r= 0.095), K (r= 0.035), Zn (r= 0.017), Fe (r= 0.066), Mn (r= 0.317) and Cu (r= 0.182) of soils under mustard cultivation and non significant and negatively correlated with P (r= -0.228) soils of mustard crop. These results are supported by the findings of Nandapure *et al.* (2011).

Iron

The Fe content in mustard leaves showed non significant and positive correlation with N (r= 0.040), P (r= 0.081), K (r= 0.003), Zn (r= 0.173), Fe (r= 0.155) and Mn (r= 0.075) of soil under mustard cultivation. These results are in conformity with the findings of Sanwal (2008) and Nandapure *et al.* (2011).

Copper

Copper content in mustard leaves had shown non significant and positive correlation with N (r= 0.039), P (r= 0.075), K (r= 0.085), Zn (r= 0.467), Cu(r= 0.028) and Mn (r= 0.221) of soil

under mustard cultivation. These results get support from the findings of Nandapure *et al.* (2011).

Manganese

In case of mustard plant Mn content had shown non significant and positive correlation with N (r= 0.074), P (r= 0.147), K (r= 0.021), Zn (r= 0.136), Fe (r= 0.039) and Mn (r= 0.117) of soils under mustard cultivation. These results are supported by the findings of Sanwal (2008) and Nandapure *et al.* (2011).

Table 1: Available soil nutrients status under mustard crop

Sample code No.	Available nutrients (kg ha^{-1})			DTPA Extractable Micronutrients (ppm)			
	N	P_2O_5	K_2O	Zn	Fe	Cu	Mn
S_{41}	114.82	40.08	261.31	0.29	1.76	0.04	5.81
S_{42}	99.44	26.74	252.10	0.40	3.98	0.02	5.51
S_{43}	123.62	31.22	256.84	0.38	1.99	0.04	5.57
S_{44}	89.32	29.43	252.27	0.34	4.21	0.12	5.54
S_{45}	94.22	26.74	238.44	0.33	2.89	0.27	5.60
S_{46}	134.31	35.70	235.85	0.25	3.75	0.12	5.64
S_{47}	150.67	40.18	219.43	0.27	1.73	0.06	5.82
S_{48}	54.10	40.56	246.79	0.28	1.71	0.02	5.82
S_{49}	136.09	40.42	230.61	0.29	1.78	0.08	5.83
S_{50}	101.73	41.08	239.33	0.34	1.79	0.04	5.82
S_{51}	91.22	38.39	213.39	0.35	2.03	0.04	5.81
S_{52}	94.15	43.56	282.25	0.37	1.74	0.02	5.83
S_{53}	54.13	32.12	238.30	0.50	1.79	0.02	5.82
S_{54}	54.13	41.08	225.17	0.48	1.75	0.06	5.77
S_{55}	143.97	34.41	250.73	0.49	1.78	0.04	5.83
S_{56}	150.67	44.57	280.45	0.44	1.74	0.02	5.84
S_{57}	149.43	35.70	284.55	0.40	2.13	0.04	5.77
S_{58}	150.67	40.18	291.33	0.33	3.26	0.02	5.79
S_{59}	92.74	31.22	280.56	0.20	2.71	0.03	5.59
S_{60}	73.44	26.74	236.39	0.30	2.80	0.06	5.67
S_{61}	151.61	24.05	283.36	0.34	2.71	0.02	5.69
S_{62}	158.45	15.99	270.34	0.28	1.95	0.06	5.74
S_{63}	117.08	14.20	252.96	0.35	1.91	0.04	5.77
S_{64}	150.35	21.37	270.65	0.43	2.65	0.02	5.81
S_{65}	112.05	14.20	263.37	0.39	1.81	0.02	5.77
S_{66}	54.13	36.62	252.27	0.29	1.65	0.02	5.71
S_{67}	129.31	12.41	295.85	0.30	3.02	0.12	5.80
S_{68}	124.72	15.99	227.30	0.29	1.84	0.04	5.81
S_{69}	54.13	19.57	219.43	0.38	4.05	0.04	5.84
S_{70}	73.44	37.22	246.79	0.40	1.76	0.06	5.58
S_{71}	157.25	32.12	270.25	0.37	3.06	0.04	5.83
S_{72}	109.53	29.43	251.15	0.56	2.94	0.04	5.77
S_{73}	112.05	19.57	255.25	0.52	2.13	0.02	5.84
S_{74}	149.42	12.13	255.28	0.36	3.00	0.06	5.70
S_{75}	134.13	15.99	249.10	0.42	4.30	0.06	5.64
S_{76}	150.67	21.37	242.30	0.24	4.28	0.04	5.63
S_{77}	160.10	15.99	302.65	0.58	4.18	0.02	5.90
S_{78}	124.92	19.57	270.65	0.23	3.25	0.04	5.85
S_{79}	122.52	29.43	266.52	0.22	4.15	0.04	5.37
S_{80}	107.43	26.74	260.34	0.59	4.11	0.12	5.89
Mean	115.15	28.85	255.55	0.36	2.65	0.05	5.74
Maximum	160.10	44.57	302.65	0.59	4.30	0.27	5.90
Minimum	54.10	12.13	213.39	0.20	1.65	0.02	5.37

Table 2: Plant nutrients content (per cent) in mustard plant at flowering stage

Sample code No.	N	P	K	Ca	Mg	S	Zn	Fe	Cu	Mn
P_1	3.34	0.55	3.90	0.23	0.33	0.51	14.16	17.40	4.54	15.02
P_2	3.24	0.55	2.56	0.24	0.32	0.52	12.96	17.62	4.52	15.40
P_3	3.29	0.62	2.74	0.30	0.37	0.53	14.02	24.62	4.54	15.08
P_4	3.19	0.81	2.53	0.40	0.47	0.44	12.18	26.96	4.52	14.68
P_5	3.27	0.57	3.06	0.33	0.42	0.48	14.46	18.76	4.68	14.60
P_6	3.29	0.62	3.25	0.34	0.43	0.52	14.98	23.56	4.56	15.75
P_7	3.14	0.53	2.73	0.27	0.36	0.49	14.98	22.26	4.52	15.32
P_8	3.16	0.67	3.00	0.24	0.33	0.51	15.14	21.56	4.56	14.98
P_9	3.30	0.72	2.90	0.26	0.35	0.58	12.96	20.04	4.58	15.26
P_{10}	3.65	0.78	2.69	0.37	0.46	0.54	14.38	25.13	4.62	14.60
P_{11}	3.27	0.61	3.70	0.22	0.31	0.44	13.02	24.62	4.75	14.58
P_{12}	3.14	0.54	2.70	0.34	0.43	0.39	14.58	26.48	4.62	15.73
P_{13}	3.31	0.57	2.73	0.33	0.42	0.47	12.39	17.52	4.56	15.01

P_{14}	3.50	0.55	2.60	0.20	0.29	0.53	12.33	23.65	4.52	14.65
P_{15}	3.20	0.56	2.81	0.22	0.31	0.37	13.09	26.66	4.58	15.55
P_{16}	3.70	0.77	3.90	0.27	0.36	0.41	13.03	27.22	4.70	15.68
P_{17}	3.24	0.62	2.32	0.39	0.48	0.43	13.15	20.72	4.54	15.58
P_{18}	3.12	0.69	2.50	0.37	0.46	0.48	12.63	21.45	4.52	14.45
P_{19}	3.29	0.67	2.54	0.34	0.43	0.54	13.17	17.72	4.56	15.51
P_{20}	3.24	0.53	2.65	0.29	0.38	0.47	15.19	21.96	4.56	15.09
P_{21}	3.32	0.54	3.60	0.24	0.33	0.50	14.67	18.86	4.54	14.45
P_{22}	3.78	0.61	2.64	0.27	0.36	0.53	15.00	19.32	4.52	14.46
P_{23}	3.77	0.69	2.81	0.32	0.41	0.48	12.59	17.32	4.54	14.75
P_{24}	3.19	0.80	2.91	0.25	0.34	0.32	12.67	27.06	4.54	14.38
P_{25}	2.85	0.62	3.91	0.31	0.40	0.38	14.15	17.26	4.62	14.75
P_{26}	3.28	0.72	2.45	0.35	0.44	0.40	12.42	24.84	4.53	14.40
P_{27}	3.08	0.53	2.91	0.23	0.32	0.48	15.35	26.70	4.52	14.98
P_{28}	3.10	0.55	2.62	0.31	0.40	0.56	15.35	27.58	4.54	15.62
P_{29}	3.56	0.68	2.38	0.21	0.30	0.52	15.50	23.96	4.52	15.58
P_{30}	3.44	0.62	2.14	0.24	0.33	0.42	13.40	25.40	4.63	14.50
P_{31}	3.32	0.62	2.13	0.23	0.32	0.49	14.75	19.20	4.52	14.66
P_{32}	3.23	0.73	3.05	0.28	0.37	0.48	14.35	26.68	4.83	15.53
P_{33}	3.27	0.59	3.11	0.33	0.42	0.54	14.49	21.96	4.54	14.76
P_{34}	3.12	0.52	2.24	0.26	0.35	0.42	13.53	17.37	4.54	14.76
P_{35}	3.24	0.69	2.63	0.26	0.35	0.43	12.80	26.70	4.57	14.98
P_{36}	3.28	0.62	3.12	0.27	0.36	0.44	13.10	24.68	4.54	14.60
P_{37}	3.81	0.72	2.63	0.39	0.48	0.56	15.48	27.18	4.89	15.71
P_{38}	3.25	0.79	3.95	0.30	0.39	0.47	13.40	24.68	4.52	14.60
P_{39}	3.56	0.75	3.11	0.23	0.32	0.37	12.95	24.84	4.52	14.96
P_{40}	3.64	0.54	3.83	0.38	0.46	0.54	15.38	21.96	4.56	14.76
Mean	3.32	0.64	2.90	0.29	0.38	0.47	13.85	22.74	4.58	14.99
Maximum	3.81	0.81	3.95	0.40	0.48	0.58	15.50	27.58	4.89	15.75
Minimum	2.85	0.52	2.13	0.20	0.29	0.32	12.18	17.26	4.52	14.38

Table 3: Correlation between soils nutrient with mustard plant

S. no	Soil Characteristics	Nutrient content in mustard plant									
		N	P	K	Ca	Mg	S	Zn	Fe	Cu	Mn
1	N	0.031	0.048	0.116	0.027	0.036	-0.065	0.095	0.040	0.039	0.074
2	P	0.014	0.068	0.011	0.007	0.011	-0.015	-0.228	0.081	0.075	0.147
3	K	0.073	0.161	0.060	0.285	0.294	-0.168	0.035	0.003	0.085	0.021
4	Zinc	0.220	-0.066	0.000	0.126	0.114	-0.005	0.017	0.173	0.467	0.136
5	Fe	0.099	0.192	-0.033	0.110	0.086	0.033	0.066	0.155	-0.003	0.039
6	Cu	-0.018	-0.172	0.041	0.140	0.127	0.137	0.182	-0.046	0.028	-0.112
7	Mn	0.077	-0.051	0.208	0.064	0.100	0.194	0.317	0.075	0.221	0.117

Referance

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