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ORIGINAL ARTICLE

Effect of FYM and Inorganic Fertilizer on morpho-physiological traits, Yield and Quality of Radish in Trans- Himalayan Ladakh region

Sonam Chorol,Dorjey Angchok, Phuntsog Tundup and Tsewang Tamchos
DIHAR, DRDO, C/o 56 APO, Leh

ABSTRACT
This study was conducted to assess the effect of different ratio of organic FYM and inorganic fertilizer on yield, quality of radish (Raphanus sativus L.) and to ascertain the doses of NPK fertilizers for getting higher yield under high hills dry temperate conditions of Ladakh in trans- Himalaya region. Radish has a shelf life of about 6-7 month, which plays an important role during the scarcity of vegetables in the area of Ladakh which remain cut off from the rest of the world for 5-6 month a year due to harsh climatic condition. During winter the temperature falls to -20 to -25°C where no plants can survive in open, so during this time vegetables having shelf life plays an important role. Keeping the importance of organic manures in view, the present experiment was undertaken to study the effect of different organic manures ratios (FYM)and inorganic fertilizers ratioson yield and quality of radish. It was observed that the highest leaf length was observed in the T2-110%:50%:90% NPK 30.03±12.49, while the least was observed in the T1-000%:00%:00%NPK 24.13±9.03, i.e control without any treatment.The treatment T2 was also proved to be better for the root length and yield 25.17±7.45 and 53.96±36.32 ton /ha respectively, hence it is proved that with the high dose of N there is increase in the yield and quality. In case of organic treatment, it has been observed that higher the dose higher is the yield with 41.34±28.20 for the T5.The growth,yield and quality of radish which is directly related to the judicious application of FYM and fertilizers.
***Key words**: NPK, FYM, Radish, Trans-Himalaya, Ladakh*

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INTRODUCTION

Nitrogen (N) affects all levels of plant function, from metabolism to resource allocation, growth, and development [5, 30]. Fertilizer is considered as a limiting factor for obtaining growth and yield. Thus, suitable application of fertilizer such as Nitrogen (N) may be favourable factors for the production of radish. However, use of conventional varieties and inadequate use of chemical fertilizers in an appropriate ratio by vegetable growers are the major factors responsible for the low productivity of the crop in theregion. The present investigation was therefore undertaken to find out most promising variety of radish suitable for dry temperate zone of Ladakh and to ascertain the doses of NPK fertilizers and FYM for getting higher yield under high hills dry temperate conditions of Ladakh. No crop cultivation system will be sustained if the nutrients input and output in the soil is least balanced. The farmers use chemical fertilizers as a supplemental source of nutrients but they do not apply in balanced proportion.Organic fertilizers include compost, farm yard manure (FYM), slurry, worm castings, urine, peat, green manure, bone meal, fish meal, and feather meal [23].Inorganic fertilizers include sodium nitrate, rock phosphate, limestone, ammonium nitrate, potassium nitrate, NPK fertilizers, muriate of potash (MOP), and supper phosphates [16].Both organic and inorganic fertilizers are sources of mineral elements, which plants require for effective growth and development. Essential mineral elements are required in optimum amounts and are classified into micro and macro. Nitrogen, phosphorus, and potassium have great effects in plant growth and development. Their deficiencies or excesses result in marked effects on the growth and yield of crops.Nitrogen is a chlorophyll component, and it promotes vegetative growth and green colouration of foliage [10].

Radish (*Raphanus sativus*L.) belongs to the family Brasicacceae. It is a popular root vegetable in both tropical and temperate regions. Radish (*Raphanus sativus* L.) is one of the important root vegetable crops grown under high hills dry temperate conditions of Ladakh. It finds a coveted position amongst people of Ladakh valley for its continuous supply during winter. *Raphanus sativus* L (radish) is believed to be one of the oldest root vegetable of Ladakh having the greatest shelf life for winter stocking as root vegetable. Due to heavy snowfall and sub zero temperature, no crop can be raised and area remains cut off from rest of world during winter for5-6 months. The locals of the area, therefore, keep the roots of radish, turnip, swede and carrot for use as vegetable during winters when fresh vegetables are not available. Radish is grown for its young tender tuberous root which is consumed either cooked or raw. It is a good source of vitamin-C and minerals like calcium, potassium and phosphorus. It has refreshing and diuretic properties [6]. It is also used for neurological headache, sleeplessness and chronic diarrhoea [22]. The roots are also useful in urinary complaints and piles [24]. The leaves of radish are good source for extraction of protein on a commercial scale and radish seeds are potential source of non drying fatty oil suitable for soap making illuminating and edible purposes. Being a short duration and quick growing crop, the root growth should be rapid and uninterrupted. Hence, for the production of good quality radish, optimum nutrition through organic, inorganic and biofertilizers are essential for sustainable production. Organic agriculture practices rely upon recycling of crop residues, animal manure, farm organic residues and wastes etc (29). Nitrogen (N) affects all levels of plant function, from metabolism to resource allocation, growth, and development [5, 28]. Urea-N fertilizer is widely applied in radish fertilization in southern China [31].Higher yield in radish crop depends upon cultural practices on which proper application of fertilizers and plant population have been found to contribute greatly [30].

MATERIALS AND METHODS

Location

Defence Institute of High Altitude Research (DIHAR), formerly Field Research Laboratory, located at 3500m above mean sea level and is the only institute of its kind in the world with core competence in cold arid agro-animal technology. The field experiment was conducted at DIHAR(DRDO)Leh in year 2014 and 2015.

Experimental design

The organic manures and inorganic fertilizer applied, were arranged in six treatments (Table 1) and replicated thrice following Randomized Completely Block Design (RCBD).The plot sized was 3X3=9m^2 area with ridges. The nitrogen levels used were110 %, 100% and 90% and organic manure -15 ton/ha and 10 ton/ha and control without any treatment. We kept the ratios of P (50%) and K (90%) constant so as to assess the more effect of the N on the plant. The seeds of local cultivars GyaLabuk and TsentayLabuk(figure 1) were used and as check PusaHimani which is recommended for temperate climate region by IARI. Seeds were dibbled half way down the ridges at a distance of 5cm in the soil. Thinning was done at 15 days after sowing. Seeds were sown in rows with ridges at 30x 30 cm spacing. The manures were applied during field preparation 15 days before sowing and half dose of N was applied on day of sowing and full dose P and K were applies as a basal dose in the form of urea, diammonium phosphate and murate of potash and next half dose of N of was applied at the two to three leaf stages.

Data collection and statistical analysis

Five representative plants were randomly selected from each plot and tagging of the particular plant was done for further measurement, later five values were reduced to three values by mean for two replicate, morphological data were collected during radish growing season in year 2014 and 2015.The morphological characters like leaf length(cm), leaf width (cm), leaf thickness(mm), number of leaves per plant by counting each leaf, chlorophyll content (SPAD value), dry weight of leaf and root (g),and yield attributing character data were taken at the time of harvesting root length(cm), fresh weight of root (g), root diameter at three different places –top, middle, bottom portion of the root (mm), root diameter average(top, middle and bottom), root dry weight(g),root fresh wt (g), leaf fresh weight and dry weight (g) and TSS Brix %, plant samples from all the different treatments were first weighed and then dried in the oven for 48 h at a temperature of 70ºC, then weighed to find the amount of dry matter and moisture content.Assumptions of normality were checked for all variables with Kolmogorov-Smirnov test and variables that significantly deviate from normality were log transformed.Tukey's honestly significant difference test was used to assume equal variances with $p \leq 0.05$.To test the effect of cultivar and treatment on the morphological characters, one way analysis of variance (ANOVA) and three away (ANOVA)were performed on data in SPSS.

RESULT AND DISCUSSION

Effect on Leaf Length

Turkey's HSD mean± standard deviations of morphological characters are present in table no.2 and figure 2. The highest leaf length was recorded from the treatment T2 with highest dose of N having 30.03±12.49 which is significantly different from the rest of the treatment and least was recorded in the T1- control having 24.13 ±9.03(table no.2, figure 2).It has been observed that with the increase of N dose there is increase in the leaf length.The similar result was obtained (13). If we see the result of three way ANOVA (table no.5), the treatment alone was not showing the significant result with f = .599, p = .701, in case of cultivar f = 16.946, p = .000 which was highly significant and in case of year the result was not significant f = 3.272, p = .077.The result of interaction between the three TxCxY (Treatment, cultivar and year)was not significant with f = 0.096, p =1.

Effect on Number of Leaves per plant:

Turkey's HSD mean ± standard deviations of morphological characters are present in table 2 and figure 3).Data for the number of leavesin T2 for the N @ 110% with 26.35± 13.39 with the highest value and minimum number of leaves was recorded in treatment T1 for the NPK 000%with 22.49±22.49 data was not significant from other treatments(table 2).Similar result was reported by (13), who noted that significant effect of nitrogen upto certain limits on the number of leaves. Maximum number of leaves was obtained, when 150 kg N per hectare was applied in carrot (2), incase of cultivar the value was highly significant with f=47.111 and p=0.000, the treatment with f= 1.342, p= .263 which was not significant, in case of year f= 3.163, p= .082, the result of three way ANOVA interaction shows that there was no significant differences with f=.249 and p=.998(table 5)

Effect on Root Length

The highest value was observed in the T2 with 25.17± 7.45 and minimum value for the T1 with 21.44±16.39recorded was not significant and if we see the value for the organic treatment, T5 with value of 24.30±9.99 and T6 23.64±10.91.(Table 3, figure 4), in case of interaction,the recorded data for treatment alone with f = 1.254, p= 0.299, in case of cultivar alone f = 148.160, p = 000,the data for the year alone f=5.425, p= 0.024 which is significant and in case of interaction between the three f= 0.945, p= 0.518 which was not significant (table 7).With the increase in nitrogen rate there was increase in root length, similar result was obtained by (14,21).The increase in root length and diameter may be due to the inherent characteristics of the variety. A variety may respond well to nitrogen fertilizers from various sources and different media(4).

Effect on Root Weight

The data recorded for the root weight was not significant in all the treatments, the treatment T2 with maximum mean ± standard deviation 2.93±0.53, T1(control) with minimum mean ± standard deviation 1.16 ± 0.77(table 3). If we see the date for three- way ANOVA the data recorded for the treatment alone was with f = 1.051, p= 0.399, in case of cultivar f =15.590, p= 0.000 and in case of the year f= .335, p= 0.565 and in case of interaction between the three ,f= 1.026, p=.448.(table 7)

Effect on Root Yield

The data for yield with N @110% with 53.96±36.32 for T2 and least yield was observed in T1 control with N @ 000% with 29.82±15.89 we can see that with the increase in N there was increase in the yield of the root (table3, figure 6). If we see the interaction result table 7, the treatment alonewith f= 1.051, p= 0.03, in case of cultivar alone the data revealed that the cultivar had a highly significant effect on the yield of radish root with f= 98.757, p= 0.00 and for the year alone had significant effect with f=3.961, p= 0.050 and for data of interaction between the three reveals that data is not significant f= 1.035, p= 0.439 (table 7). It was observed that there was increase in yield with the increase in nitrogen rate [1, 2, 17,27], reported that tuber yield per unit area was increased with increasing nitrogen fertilizer up to suitable level (3,9) reported that radish responds positively to nitrogen fertilization, the effect of N application up to 200 kg N /Haon root yield may either be beneficial. The effect of N on radish yield has been studied early. They found that the highest yield was obtained with the highest N rate [7]. The highest root yield was recorded for 120% NPK/ ha. The highest dose of NPK gave increased root yield by 19% over recommended dose. This higher yield could be attributed to increased growth and root yield parameters owing to accumulation of mare photo synthesis in sink. The finding is in consonance with Parathasarathi and Singh [20,26]. Similar result was observed that with high levels of irrigation and fertilizer there is increase in the yield [19].

Effect on Dry Weight of Leaf

The data observed for the dry weight of leaf revealed that there was no statistically significant difference between all the treatments, the maximum value was observed for T2 with mean ± standard deviation 3.00.00±0.00 and minimum value was observed for T6 with mean ± standard deviation 2.26±0.00.Table 4, the data of dry weight of leaf reveals that there was significant difference between the treatments and year having f = 3.489, p= 0.009 and f= 25.762, p= 0.000 respectively and in case of interaction between the treatment, year and cultivars the data observed that the values was significant having f = 3.060, p= 0.001(table 7).Increase in leaf dry weight due to increasing of nitrogen fertilizer are partially supported by Krishnappa (15).

Effect on Dry Weight of Root

The data recorded for the dry weight of root revealed that the maximum value for T2 with mean ± standard deviation 44.93 ± 1.25 and minimum value recorded for T5 with mean ± standard deviation 43.54± 1.46 .The data for dry weight of root revealed that it was not significant in case of treatment with f=2.050, p= 0.088, in case of cultivars f= 13.140, p= 0.001 which is highly significant and in case of interaction between the three, the data revealed that it was not significantly differ with f= 1.174, p= 0.321(Table 7).In respect to fresh weight and dry weight of leaves, roots and whole plant may be due to the higher level of nitrogen from inorganic and biofertilizers(9).The nitrogen will also be synthesized into amino acids which built into complex proteins and help in promoting the luxurious growth of crop (18).

Effect on Moisture Content of leaf

The maximum mean ± standard deviation was for the T3 having 46.27 ± 1.46 and minimum mean ± standard deviation was for T5 with value 54.73± 1.53 which were not significantly differs. Data of interaction, for treatment alone revealed that it's not significantly differ, f= 1.503, p=0.206, in case of cultivars alone f= 0.898, p= 0.004, which was significant and in case year alone f= 14.390, p=0.000 of interaction the data revealed that it was not significant having f = 1.127, p= 0.359(Table 7)mean ± standard deviation.

Effect on Moisture Content of Root

The maximum value was observed for the T2 with 45.94 ±1.89 and minimum value for the T5 with 44.54± 1.53.The data of moisture content of root recorded that the effect of year is highly significant with f= 14.390, p= 000, in case of cultivars the recorded is not significant having f= 1.025, p= 0.321 and interaction between the two the data revealed that the value is significant having f= 4.326, p= 0.006 (Table 7).And in case of the effect on the moisture content of the leaf among the treatment there was no significant difference among them.

Effect on TSS of the root

The highest value was recorded in T2 with N @ 110% and lowest value was observed in T1 control with N @ 000% with 6.26±1.47 and 5.08±1.47 respectively (Table 2 and figure5).The data recorded for the TSS of root in case of treatmentalone was significant with f= 3.899, p= 0.005, cultivars with f= 25.780, p= 000 which is highly significant and in case of interaction between the three data was not significant with f= 1.791, p= 0.061(Table 6).Root quality in terms of TSS content was highest at the highest N rates(11, 12).

Effect on visual characters of radish

Texture is an important factor determining the sensory quality of vegetables. There was a great variation between the C1 and C2 cultivars of *Raphanus sativus* L. with respect to their skin colour, root shape and texture. C2 has bright pink colour with slight white colour while C1 has completely white skin colour with rough texture with hairs on the root while C2 is with less number of hairs.

Correlation:

Pearson correlation among different morphological characters is present in table 8. The result showed that leaf morphological characters (leaf length, leaf width and leaf thickness) is negatively correlated to the chlorophyll content and leaf thickness positively correlate to chlorophyll content.Moisture content of leaf is positively correlated to leaf thickness and chlorophyll content of leaf. Dry weight of root is positively correlated to the moisture content of leaf, root length, root weight, root volume and root diameters.

Root morphological characters -root length are positively correlated to the root weight, root volume, root diameters, root weight- positively correlated to the root volume and root diameters and TSS. Root volume – positively correlated to the root diameters and negatively correlated to rind thickness of root.In case of yield, it is positively correlated to the dry weight of root, moisture content of leaf and root and negatively correlates to dry weight of leaf. The data which were positively or negatively correlated were statistically significant at ** p≤0.01, * p≤ 0.05.

Table 1: Treatment design

TREATMENT	COMPOSITION
T1	Control (no treatment)
T2	110%:50%:90% NPK
T3	100%:50%:90% NPK
T4	90%:50%:90% NPK
T5	15Ton/ha FYM
T6	10 Ton/ha FYM

Table 2: Effect of FYM and NPK on growth, yield and yield contributing characters of radish

S.N.	TREATMENT	Number of leaves per plant	Leaf length (cm)	Leaf thickness (mm)	Leaf width (cm)	Chlorophyll content (SPAD value)	Rindthickness (mm)	TSS (Brix %)
1	T1	26.35±13.39	24.13±9.03	0.46±0.05	1.11±0.18	35.97±3.46	0.49±0.15	5.08±1.47
2	T2	23.81±3.05	30.03±12.49	0.45±0.07	1.13±0.21	35.51±5.05	0.53±0.13	6.26±0.55
3	T3	22.76±9.85	27.69±8.96	0.45±0.07	1.17±0.13	36.07±3.52	0.53±0.17	6.15±1.08
4	T4	22.49±12.21	25.88±9.27	0.45±0.04	1.14±0.15	37.85±4.46	0.53±0.18	6.13±0.65
5	T5	24.06±9.69	27.36±6.71	0.46±0.04	1.13±0.13	38.06±4.61	0.64±0.26	5.54±0.88
6	T6	28.85±7.92	26.03±8.61	0.47±0.04	1.15±0.14	37.37±3.12	0.55±0.18	5.45±1.21

Values represents the mean±SD; for each column

Table 3: Effect of FYM and NPK fertilizer on growth, yield and yield contributing characters of radish

S.N	TREATMENT	Root length (cm)	Root weight (kg)	Root volume (ml)	Root diameter top(mm)	Root diameter Middle(mm)	Root diameter Bottom(mm)	Root Yield ton/ha
1	T1	21.44±16.39	1.16±0.77	2.85±0.51	1.98±0.06	83.14±16.54	51.16±24.90	29.82±15.89
2	T2	25.17±7.45	2.93±0.53	2.90±0.47	1.98±0.06	89.92±9.16	59.30±14.43	53.96±36.32
3	T3	24.66±8.45	2.73±4.86	2.80±0.54	2.00±0.02	87.44±12.19	57.19±13.98	51.14±25.49
4	T4	24.34±8.15	2.55±0.84	2.75±0.55	1.99±0.04	86.49±16.83	53.39±19.86	46.85±18.89
5	T5	24.30±9.99	1.55±0.85	2.00±0.44	2.00±0.04	84.85±14.81	61.67±16.33	39.81±10.71
6	T6	23.64±10.91	1.47±1.24	1.83±0.69	1.99±0.05	89.87±18.26	60.77±21.79	34.34±28.20

Values represents the mean±SD; for each Colum

Table4: Effect of FYM and NPK fertilizer on growth, yield and yield contributing characters of radish.

S.NO.	TREATMENT	Moisture content of root (%)	Moisture content of leaf (%)	Dry weight of leaf(g)	Dry weight of root(g)
1	T1	1.95±0.02	45.19±1.51	2.29±0.01	1.65±0.02
2	T2	1.95±0.01	45.94±1.89	2.29±0.00	1.64±0.01
3	T3	1.95±0.01	45.79±1.35	2.28±0.01	1.65±0.01
4	T4	1.95±0.02	45.52±1.48	2.29±0.00	1.65±0.01
5	T5	1.94±0.01	44.54±1.53	2.28±0.01	1.64±0.01
6	T6	1.95±0.01	43.62±1.36	2.29±0.00	1.65±0.01

Table5: Three-way ANOVA for functional traits in the radish.

		F					
	df	Leaf Length (cm)	Leaf Thickness (mm)	Leaf Width (cm)	No. of leaves/ plant	CHLOROPHYLL CONTENT (SPAD value)	TSS (Brix %)
T	5	.599	.395	.266	1.342	1.447	3.899**
C	1	16.946***	6.949*	23.563***	47.111***	28.396***	25.780***
Y	1	3.272	21.889***	5.425*	3.163	18.179***	.007
TXCXY	5	2.067	.945	1.170	1.161	1.198	3.733**

Treatment effects, cultivars effects and their interaction (C×TxY) were considered as fixed effects. The F ratio (F) and P-values (P) are presented for each factor, d.f., Degrees of freedom. * Significant at $p \leq 0.05$, ** significant at $p \leq 0.01$*** significant at $p \leq 0.001$.

Table6: Three-way ANOVA for functional traits in the radish.

	F						
	Df	Root length(cm)	Root volume(ml)	Root weight (ton/ha)	Root diameter top(mm)	Root diameter middle(mm)	Root diameter bottom(mm)
T	5	1.254	.623	1.051	.728	.709	1.315
C	1	148.160***	276.725***	15.590***	16.202**	53.556***	71.772***
Y	1	3.416	.101	.335	7.347	1.628	1.281
TXCXY	5	.954	1.195	1.026	.598	1.213	.956

Treatment effects, cultivars effects and their interaction (C×TxY) were considered as fixed effects. The F ratio (F) and P-values (P) are presented for each factor, d.f., Degrees of freedom. * Significant at p ≤ 0.05, ** significant at p ≤ 0.01*** significant at p ≤ 0.001

TABLE7: Three-way ANOVA for functional traits in the radish.

	F						
	Df	Root rind thickness (mm)	Moisture content of leaf (%)	Moisture content of root (%)	Dry weight of leaf(g)	Dry weight of root (g)	Yield /hectare
T	5	7.868***	1.503	2.502*	3.389**	2.050	4.221**
C	1	478.443***	8.898*	35.702***	2.371	13.140***	98.757***
Y	1	.026	14.390***	2.850	25.762***	6.018**	3.96*
TXCXY	5	1.752	1.127	.555	3.060***	1.174	1.035

Treatment effects, cultivars effects and their interaction (C×TxY) were considered as fixed effects. The F ratio (F) and P-values (P) are presented for each factor, d.f., Degrees of freedom. * Significant at p ≤ 0.05, ** significant at p ≤ 0.01*** significant at p ≤ 0.001

Table no.:4b Correlation Matrix

	variety	treatment	year 2014	leaf length (cm)	leaf thickness (mm)	leaf width(cm)	chlorophyll content SPAD value	root length (cm)	root weight (kg)	Root volume (ml)	Rind Thickness (mm)	TSS(%)	Root Diameter top(mm)	root diameter middle (mm)	root diameter bottom (mm)	YIELD/plot	ton/hac	dry weight of leaf(g)	dry weight of root(g)	Moisture Content of root(g)	Moisture Content of leaf (g)
variety	1	0	0	.483**	-.259*	.538**	-.485**	-.819**	-.427**	-.893**	.898**	.460**	-.437**	-.652**	-.709**	-.709**	-.724**	0.129	-.370**	-.575**	-0.303**
treatment		1	0	0.01	0.118	0.056	0.198	-0.103	0.032	0.033	0.161	0.031	0.091	0.072	0.074	-0.011	-0.01	-0.083	0.071	-0.103	0.034
year 2014			1	-0.212	-.488**	-.258*	-.388**	-0.124	0.063	-0.017	-0.007	0.007	-.294*	-0.114	-0.095	-0.221	-0.145	-.425**	-.250*	-0.162	-0.385**
leaf length (cm)				1	-0.099	.845**	-.351**	-.340**	-.247*	-.495**	.456**	0.167	-.236*	-.312**	-.333**	-0.215	-.236*	0.152	-0.188	-0.185	-0.096
Leaf thickness (mm)					1	-0.115	.574**	.323**	-0.158	.316**	-0.167	-0.132	.328**	.396**	0.225	0.149	0.103	0.119	.342**	0.262*	0.279*

-0.091	0.318**	0.360**	0.149	0.327**	-0.323**	-0.270*	0.233*	0.314**	0.273*	0.427**	0.396**	0.125
-0.304**	0.389**	0.507**	0.185	0.517**	-0.528**	-0.390**	0.506**	0.517**	0.455**	0.484**	0.480**	0.037**
-.237*	.469**	.374**	0.173	.400**	-.326**	-0.066	0.228	.344**	.364**	.360**	.334**	0.01
0.056	0.178	-0.098	-0.031	-0.058	0.105	0.022	0.115	-0.044	0.091	-0.032	-0.073	1
-.268*	.351**	.533**	.425**	.653**	-.660**	-.370**	.270*	.404**	.515**	.996**	1	
-.247*	.382**	.533**	.401**	.644**	-.644**	-.358**	.288*	.408**	.511**	1		
-.419**	.361**	.615**	.298*	.691**	-.649**	-.369**	.499**	.786**	1			
-.357**	.349**	.667**	0.19	.693**	-.631**	-.326**	.715**	1				
-0.194	.338**	.482**	.233*	.541**	-.348**	-.492**	1					
0.184	-0.183	-.431**	-.251*	-.491**	.266*	1						
.486**	-.310**	-.759**	-.434**	-.786**	1							
-.509**	.506**	.787**	.394**	1								
-0.165	-0.05	.282*	1									
-.331**	.382**	1										
-.405**	1											
1												
leaf width(cm)	chlorophyll content SPAD value	root length (cm)	root weight (kg)	root volume (ml)	rind thickness (mm)	TSS(%)	root diameter top(mm)	root diameter middle (mm)	root diameter bottom(mm)	YIELD/plot	ton/hac	dry weight of leaf(g)

dry weight of root(g)																	1	0.544**	0.456**
moisture content of root(g)																		1	0.462**
moisture content of leaf(g)																			1

**. Correlation is significant at the 0.01 level (2-tailed),*. Correlation is significant at the 0.05 level (2-tailed).

CONCLUSION

Radish yield and vegetative parameters are greatly affected by nitrogen application. The data recorded that with the high dose of nitrogen on radish plant there was positive effect on the parameters which had been reported earlier. Interaction between the treatment and cultivar result shows that the cultivar effect is more as compare to the treatment in this experiment almost for all the characters. From this study the following conclusions were drawn:

1) The N @ 110% increased the yield of radish in Leh condition.

2) As compare to the N@ 90% the FYM @10 ton/ha showed higher yield.

3)The N @ 110% is the most economic and optimum level for the radish production under Leh condition. Comparing the cultivars, the C2 cultivar data were significant as compare to C1. The generated data could be use as a reference for selection of radish variety (cultivar) in commercial scale of radish farming. However, future works are need for further research.

1) Effect of organic manures in combination with nitrogen fertilizer on the quality of radish.

2) There is need for different radish varieties for the suitability under organic production.

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