

# Effect of Spacing & Potassium Application on Growth and Yield of Radish *Raphanus Sativus* Cv Mino Early

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## ABSTRACT

Optimum use of potassium (K) fertilizer and proper plant geometry can be effective way to increase radish productivity. A field experiment was conducted at Horticulture farm of IAAS, Lamjung Campus, Nepal during October-December, 2017 to study the effect of K and spacing on growth and yield of radish cv Mino Early. Three replications of five levels of K (0, 20, 30, 40 and 50 kg ha<sup>-1</sup>) and three levels of spacing (20 cm x 10cm, 20cm x 20 cm and 20cm x 30 cm) were laid out in randomized complete block design. We found highly significant effect of spacing and K on yield and its attributes. Maximum number of leaves, shoot weight, shoot per plot, root length, root girth, root weight and root yield (48.01 ton) was obtained with application of 50kg K<sub>2</sub>O ha<sup>-1</sup> whereas minimum value was obtained with control for all parameters. K level from 20-50 kgha<sup>-1</sup> resulted similar yield attributes and yield. In case of spacing, 20cm x 30 cm produced maximum number of leaves, shoot weight, shoot per plot, root length and root girth but root yield was minimum. 20cm x 20 cm spacing resulted maximum root yield (50.94 ton ha<sup>-1</sup>). Interaction effect of spacing and potassium was found to be significant for none of the parameters. These results suggested that total root yield can be increased by planting radish at spacing of 20cm x 20cm and of 20 kg K<sub>2</sub>O ha<sup>-1</sup> might be economic to use but further research with same levels of K and spacing is suggested.

**Keywords:** Girth, Interaction, Potassium, Radish, Spacing

## INTRODUCTION

Radish is one of the extensively grown vegetable crop of Nepal which belongs to the family Cruciferae. It is grown in every part of Nepal as single or mixed crop. Its popularity may be due to wider climatic adaption, easy cultivation and

wider use (Shrestha and Shakya, 2004). Radish production of Nepal is 268119.6 metric tons under area of 16915.7 ha with productivity of 15.9 metric tons/ha. Yield of radish is affected by many factors such as agronomic factors (irrigation, fertilization, type of seed used, planting method, plant spacing), climatic factors (temperature, relative humidity, growing season, rainfall, soil fertility). Among these various factors spacing between plants and optimum use of fertilizer play crucial role in the good yield and proper quality of radish.

Optimum spacing avoids shading effect on plants and intraspace competition. Higher yield per unit area can be obtained by from proper plant geometry. It is due to the fact that proper plant geometry minimizes competition for nutrition, light, radiation, water etc. Low and improper fertilization results poor production of radish. Potassium regulates the opening and closing of stomata. It activates enzymes which are required for generation of ATP. Starch and protein synthesis are facilitated by potassium in plants. Potassium is required for transport of sugars to the storage organs. Thompson and Kelly (1957) reported that potassium is essential for the formation and translocation of carbohydrates and needed in large quantities by most of the root crops.

Productivity of radish in Nepal is reported to be low i.e. 15.9 metric tons/ha (MOAC,2014) as compared to other top radish producing countries. Knowledge about optimum dose of nutrients and proper crop geometry is lacking among radish growers. Although nitrogen and FYM are applied in large quantity by farmers, use of potassium is found to be very low. There is sufficient scope for increasing yield and quality of radish by judicious application of potassium and maintenance of proper plant spacing. Therefore, this study was carried out to find proper dose of potassium and spacing for optimum yield and quality of radish.

## MATERIALS AND METHODS

This experiment was carried out at Horticulture farm of IAAS, Lamjung Campus during the year 2002. The treatment details are as follows:

Potassium:	Spacing:
K0: 0 kg ha <sup>-1</sup>	S1: 20 cm x 10 cm
K1: 20 kg ha <sup>-1</sup>	S2: 20 cm x 20 cm
K2: 30kg ha <sup>-1</sup>	S3: 20 cm x 30 cm
K3: 40 kg ha <sup>-1</sup>	
K4: 50 kg ha <sup>-1</sup>	

The experiment was laid out in two factorial RCBD design with three replications comprising 15 treatments. Each plot size was of 1 m<sup>2</sup> for each treatment. Variety sown was Mino early. Plant spacing was maintained according to treatments. Crop was fertilized with 100 kg N and 80 kg P whereas K was applied according to treatment. Full dose of P, K and half dose of N was applied as basal dose. Remaining half dose of N was applied in two split doses at 20 and 35 DAS. Parameters studied were number of leaves, shoot weight, shoot yield per plot, root length, root girth, root weight, root yield per plot and root yield per hectare. All the parameters were taken at harvest. Data were entered to MS-Excel 2013 and analyzed using R studio 1.1.423.

## RESULTS AND DISCUSSIONS

### Effect on growth characters

Different level of potassium showed significant effect while spacing showed highly significant effect on growth characters. Interaction effect was found to be non-significant. Potassium dose of 50 kg ha<sup>-1</sup> produced maximum number of leaves (23.41), shoot weight (210.06 gm and shoot per plot (5.19 kg). Effect of 20 kg ha<sup>-1</sup>, 30 kg ha<sup>-1</sup> and 40 kg ha<sup>-1</sup> was statistically similar for number of leaves and shoot per plot. Minimum number of leaves (21.42), shoot weight (187.30 gm) and shoot per plot (4.52 kg) was obtained with control. Better growth with high potassium levels might be due to key role of potassium in activation of enzymes, stomata regulation and photosynthesis. Mahadevbhai (2007) and Abou El-Nasr and Ibrahim (2008) reported similar results.

SN	Treatment	No. of leaves	Shoot weight	Shoot per plot	Root length (cm)	Root girth (cm)	Root weight (gm)	Root per ha (ton)
	<b>Potassium (kg ha<sup>-1</sup>)</b>							
1	<b>0 kg</b>	21.42b	187.30b	4.52b	23.36b	11.15b	182.73c	43.94b
2	<b>20 kg</b>	21.95ab	190.00b	4.87a	23.52ab	11.58ab	184.47bc	45.89ab
3	<b>30 kg</b>	22.58ab	200.87ab	4.95a	24.54ab	12.41ab	196.82abc	46.19ab
4	<b>40 kg</b>	23.32a	207.72ab	5.19a	25.39a	13.09a	201.25ab	47.99a
5	<b>50 kg</b>	23.41a	210.06a	5.19a	25.41a	13.10a	202.75a	48.01a
	<b>LSD</b>	1.526	18.28	0.327	1.785	1.42	15.68	2.886
	<b>SE</b>	0.525	6.29	0.113	0.614	0.491	5.395	0.993
	<b>Significance</b>	*	*	*	*	*	*	*
	<b>Spacing</b>							
1	<b>20 cm x 10 cm</b>	20.62b	128.17c	5.03b	21.20b	10.54b	107.68b	48.84a
2	<b>20 cm x 20 cm</b>	23.39a	228.04b	5.54a	25.96a	12.96a	237.91a	50.94a
3	<b>20 cm x 30 cm</b>	23.71a	246.47a	4.25c	26.40a	13.42a	241.36a	39.17b
	<b>LSD</b>	1.182	14.16	0.253	0.476	1.10	12.14	2.236
	<b>SE</b>	0.407	4.87	0.087	1.383	0.381	4.17	0.769
	<b>Significance</b>	**	**	**	**	**	**	**
	<b>Interaction</b>	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>	<i>ns</i>
	<b>LSD</b>	2.64	31.67	0.195	1.064	2.47	27.16	4.99
	<b>SE</b>	0.909	10.89	0.567	3.092	0.851	9.34	1.720
Means in same column followed by similar lowercase are not significantly different by Duncan test **=Highly significant, *=Significant and ns=Non-Significant								

20 cm x 30 cm showed superior number of leaves (23.71) and individual shoot weight (246.47 gm) whereas yield was minimum (4.25). Lowest number of leaves (20.62) and individual shoot weight (128.17 gm) was found on 20 cm x 10 cm spacing. Maximum shoot yield per plot (5.54 kg) was obtained from medium spacing i.e. 20cm x 20cm. Availability of more nutrients, water, light and less competition in wider spacing might have resulted more number of leaves and shoot weight, however due to lower number of plant population yield per plot was minimum. This result is supported by Hossain et al. (2008) and Sharma et al. (2013).

#### Effect on yield attributes

Significant effect of K was found on yield attributes. Maximum root length (25.41 cm) and root girth (13.10 cm) was recorded with potassium dose of 50 kg ha<sup>-1</sup>. Minimum root length (23.36 cm) and root girth (11.15 cm) was recorded

with control. Maximum root length and root girth resulted maximum individual root weight (202.75 gm) with highest potassium dose and minimum individual root weight (182.73 gm) was obtained with control. Potassium level of 40 kg ha<sup>-1</sup>, 30 kg ha<sup>-1</sup>, 20kg ha<sup>-1</sup> showed similar effects with 50 kg ha<sup>-1</sup> for root length and root girth. Increased yield attributes with increased level of potassium may be attributed to the role of potassium in synthesis and translocation of carbohydrate, cell extension and improved nitrogen use efficiency. Mahadevbhai (2007), Ali et al. (2003) and Khan et al (2016) also reported that improved root length, root girth and root weight can be obtained with increased potassium fertilization.

Similarly, spacing showed significant variation in yield attributes. Plant sown at 20cm x 30 cm spacing produced longest root (26.40 cm), widest root (13.42 cm) and maximum root weight (241.57 gm) whereas shortest root (21.20cm), minimum root girth (10.54cm) and lowest root weight (107.68 gm) was obtained with 20cm x 10cm spacing. However, spacing of 20cm x 30 cm was at statistically similar with 20cm x 20cm for all parameters. More number of leaves with availability of nutrients, water and other resources might have resulted improved yield attributes in wider spacing whereas high competition among plants for these resources along with lower number of leaves have resulted poor yield attributes in narrow spacing. This result matched with the findings of Pervetz et al (2004), Khan et al (2016) and Sharma et al (2013). The interaction effect of potassium and spacing was found to be non-significant for all yield of the attributes.

#### **Effect on root yield**

Potassium application significantly influenced root yield. 50 kg K<sub>2</sub>O ha<sup>-1</sup> resulted maximum root yield (48.01 ton ha<sup>-1</sup>). Yield was increased by 9.26% with potassium level of 50kg ha<sup>-1</sup> than with control which resulted lowest yield. Potassium level of 40 kg ha<sup>-1</sup>, 30 tons ha<sup>-1</sup>, 20 kg ha<sup>-1</sup> produced similar yield as that of 50 tons ha<sup>-1</sup>. High yield with high dose of potassium may be attributed to its function in crucial role in the photosynthesis and translocation of carbohydrates and better yield attributes. Longest root length and widest root girth with highest dose of potassium might have resulted maximum yield. These results are supported by Mahadevbhai (2007), Abou El-Nasr and Ibrahim (2008), El-Bassiouny et al. (2003).

Varied level of spacing significantly influenced root yield of radish. 20 cm x 20cm resulted maximum yield (48.84 ton ha<sup>-1</sup>). Yield was 30.17% more with 20cm x 20cm spacing as compared with 20cm x 30 cm which produced lowest yield. 20 cm x 20 cm and 20 cm x 10 cm spacing resulted statistically similar yield. Despite higher root length, root girth and root weight at 20 cm x 30 cm, lowest yield was due to lowest plant population. Although plant population in narrow spacing was high, yield was still lower which might be due to poor root characteristics of individual plant. Spacing of 20cm x 20cm resulted maximum root yield which may be attributes to optimum plant population and individual root characteristics. Sharma et al (2016) also found similar results which reported that despite better performance of individual plants in wider spacing, it fails to overcome loss in yield due to lower plant population. Interaction effect of potassium and spacing was non-significant for root yield.

#### **CONCLUSION**

From the above findings it can be concluded that K influences number of leaves, shoot weight, shoot yield, root length, root girth, root weight and root yield due to its positive effect on stomata regulation, photosynthesis, translocation of nutrients, activation of enzymes and improved nitrogen use efficiency. K dose from 20-50 kg ha<sup>-1</sup> resulted similar yield attributes and yield. So, 20 K<sub>2</sub>O kg ha<sup>-1</sup> may be economic to use but there are possibilities of luxury consumption of potassium. Incase of spacing, maximum root length, root girth and individual root weight can be obtained when radish plants spaced at 20 cm x 30 cm. Total yield is reduced at higher level of spacing due to lower plant population fails to overcome the loss due to lower number of plants Further research with same levels of K and spacing is suggest

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