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Research Article

Effect of Potassium on Disease Severity of Alternaria Leaf Spot in Radish

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Abstract

Radish (*Raphanus sativus*) is a popular root crop belonging to the family Cruciferae. *Alternaria* leaf spot is a major disease causing considerable yield loss due to defoliation. Present investigation was undertaken to find out the effective dose of potassium for management of *Alternaria* disease in radish. Field trial was conducted on Horticultural farm IAAS, Lamjung, Nepal during October-January,2017/18 in Randomized Complete Block Design with four replications and five treatments. The doses of potash (30, 45, 60, 75 and 90 kg/ha) were tested in the commonly cultivated variety, Mino early. Disease severity was measured in 10 days interval and Area Under Disease Progress Curve (AUDPC) was calculated. The AUDPC was found significantly higher at 30 kg/ha (40.25) and lowest was obtained at 90 kg/ha (25). On measuring the yield parameters, root length was significantly longest at 75 kg/ha (36.88 cm) and same treatment gave highest root weight 403.4g. Root girth and plant height between the treatments was found non-significant. The results show 75 kg of potash per ha (125% of government recommended dose) of potash was found most effective treatment

Keywords: AUDPC; Leaf Spot; Yield Parameters

Introduction

Radish (*Raphanus sativus* var. *longipinnatus*) is a crop of Brassicaceae family. This family comprises of 372 genus and 4060 species which includes different vegetables like cabbage, cauliflower, broccoli, mustard etc. commonly called as Cole crops. Radish which ranks high in importance in China, Japan, Korea and Yemen is estimated to have 7 million ton/year i.e. about 2% of the world production of vegetables [1]. Radish is one of the most popular root vegetable crops, successfully grown throughout the year in the hills of Nepal (Poon., *et al.* 2004). Its popularity may be due to wider climatic adaptation, easy cultivation methods and wider range of its uses [2]. Radish can be consumed as in different forms like pickle, curry and salads and has low calories and high vitamin C, folate, potassium, magnesium and other traces number of micronutrients [3]. It contains compound sulforaphane which protects body from cancer and improves the digestion, immune system, respiratory health and bone health. Cultivated area of radish was found to be 16,570 ha with total production of 2, 19,230 tons and an average productivity of 13.23 t ha^{-1} in Nepal [4]. Vegetable crops are attacked by a number of diseases among them, the most important one is leaf defoliating disease (*Alternaria* leaf spot, cercospora leaf spot etc.). It has been found that yield loss due to *Alternaria* in cotton from India and Israel was 37% and 25% respectively [5,6]. Thirty two to fifty seven percent of average yield loss due to *Alternaria* have been suggested by several workers (Conn and Tewari, 1990). Radish is prone to attack of Viruses, phytoplasmas, bacteria and fungi, resulting in a decline in productivity [7]. *Alternaria spp.* (Class: Duteromycetes, order: melanconiales) causes the *Alternaria* leaf spot of radish. It produces conidia asexually in the host. Conidiophores has muriform shape, which is broad at the base and tapering at the tip and traverse septa with intercellular mycelium at first then intracellular. The crop attacked by *Alternaria* shows the symptoms small foliage surface, circular spot is seen in all floral parts, peduncle, pods, fruiting bodies (siliqua). As mentioned earlier, spots found in floral parts and foliage of the crop have of 1cm or more in diameter concentric ring with color gray, gray-tan, near black with disease progression. These spots coalesce and make the affected portion blighted and cause

the great yield loss. Research works are mostly focused towards getting higher yield from the healthy plants. Optimum fertilization with nitrogen and potassium is very necessary for the production of high quality crops and maximizing yield (Kale and Massalkar, 1993). Present information on characterization and management of nutrient doses for *Alternaria* leaf spot in Radish is inadequate. In developing country like Nepal, there are various misconception prevailing about fertilizer doses. There is a common belief among people of illiterate community that higher fertilizer doses give higher yield. This may lead to the occurrence of various devastating diseases in presence of high dose of fertilizer. Radish is popular root crop in Nepalese society having uncountable benefits to the human health. However, its productivity is low in the field condition. One of the factors for low productivity may be outbreak of disease. Disease may conquer in the radish field from various sources like debris, seed, air, cultural practices and use of imbalance nutrients. The disease affecting the plant health and yield attributing parameters of crops can be managed through nutrient management approach. Nutrient management includes proper application of required fertilizers in the soil. Among nutrients, macronutrient Nitrogen and potassium play a vital role in disease management. The interaction between N and K found beneficial in reducing leaf foliating disease in the field (Spectrum analytic, 1980). Higher amount of nitrogen provides the profuse vegetative growth which makes the plant vulnerable to disease. Shortage of potassium exudates the higher amounts of compounds such as sugars and amino acids that promote the establishment of fungal disease infection in the plant. Most of the research is done for management of disease by fungicides application but there is negligible amount of research that are concentrated towards management of diseases through nutrient management approach. Application of nutrients for disease management is more economical than fungicides application. Existing nutrient recommendations are unable to suggest the optimum nutrient doses for producing healthy and vigorous plant along with protection of crops from different diseases. Hence, the present investigation was taken up to study the use of fertilizer in an ideal amount for increasing yield as well as for the management of leaf spot of radish caused by *Alternaria* species. AUDPC is commonly a trapezoidal method of measuring quantitative summary of disease intensity between each pair of adjacent disease rating over time [8]. Consider the sample time points in a sequence $\{t_i\}$, where the time interval between two time points may be consistent or may vary, and associated measures of the disease level $\{y_i\}$. Then AUDPC (Ak) is calculated as:

$$Ak = \sum_{i=1}^{Ni-1} \frac{2}{(y_1 + y_{i+1})\,(t_{i+1} - t_i)}$$

Materials and Methodology

Field trial was conducted on horticultural farm of Lamjung Agriculture Campus, Lamjung, Nepal (latitude: 28.125896; longitude: 84.416133 and altitude: 630.02m) between Oct-Jan 2017/18 on radish crop following Randomized Block Design with four replications and five treatments. Different doses of Potash viz. 50%, 75%, 100%, 125% and 150% of government recommended dose were evaluated for their field efficacy against *Alternaria* leaf spot of radish. Government recommended dose of NPK is 200:180:60 kg/ha respectively (Krishi Diary 2074). Full dose of P and K while 50% of N was supplied during seeding while remaining N was supplied in equal proportion in each treatment at 30 and 45 days after seeding. One thousand and twenty eight gram (1028 gm) well rotten farm yard manure (Krishi Diary 2074) was applied per plot while seeding. The plot size was maintained at $0.8m^2 \times .8m^2$ holding16 plants per plot keeping row to row 20 cm and plant to plant distance 20 cm, leaving the spacing 50 cm between the plots. Irrigation was done daily up to germination then 2 days interval. The radish cultivar Mino early, widely grown in this locality and susceptible to above mentioned disease was used for the trial. Four plants were under observation. *Alternaria* leaf spot was first observed in the field during Dec- 2017. Yield parameters viz. Root length, root girth, plant height and root weight were recorded. *Alternaria* leaf spot was rated using scale (0 - 5) given by Townsend and Heuberger (1943). AUDPC was also calculated. The data were analyzed statistically using Gene-stat 15^{th} edition. Mean separation was done using Least Significant Difference (LSD) and Duncan's Multiple Range Test (DMRT) at 5% significance level. (Gomez and Gomez, 1984) The correlation between yield and AUDPC levels was calculated and graphed using MS-Excel.

Results and Discussion

Alternaria leaf spot

Analysis was done for the effect of doses of potash fertilizers on AUDPC and following result was obtained.

Significant effect was found in AUDPC with respect to potash level. AUDPC was found lowest in the plant receiving at 90 kg/ha of MOP (25) which was statistically at par with 75 kg/ha and 60 kg/ha of MOP. Highest AUDPC was found at 30 kg/ha (40.25) and

statistically at par with 45 kg/ha of MOP (Table1). Khatun., *et al.* [9] found that increasing the doses of potassium with certain level of nitrogen decreases the *Alternaria* leaf spot. Twenty-three to thirty percent disease severity was increased in case of reducing and tripling the rate of potassium to standard rate (13.2 kg/ha/week) in green house condition. However, doubling the rate of potassium rate to standard rate decreased disease severity only by 10 - 15% [10]. It has been found that both soils applied, and foliar application of potassium decrease the *Alternaria* leaf spot in cotton where in low level of potassium in soil [11], Harris (1997) and Zhao., *et al* [12]. Bhuiyan., *et al.* [13], Balachinski., *et al*. [14] found that potassium nitrate as a foliar application decrease the *Alternaria* leaf spot on cotton, potato and tomato crops. Noble Usherwood reported that from 534 references, K improved the plant health in 65% of the studies and was deleterious 23% of the time. The deleterious effect could be due to the inhibition of K uptake by the excess uptake of Mg, Ca and/or NH_4-N. Overall, the application of potassium decreased the fungal disease infestation by 14% where soil test levels was unknown. The result might be due to the K involved in essentially cellular activity as a mobile regulator of enzymatic activity that influence the disease severity. Potassium is the important cation in the regulation of stomata regulation and cellular activities of crop and it also acts as transporter of photosynthates at the site of storage from production site. Foliar-applied potassium chloride has been shown to control fungal disease probably due to osmotic effects on the fungal pathogens, disrupting pathogen development and subsequent infection. Application of potassium to deficient soils usually increases plant resistance to diseases. It might be partly related to the effect of potassium in increasing epidermal cell wall thickness or disease escape as a result of vigorous crop growth, although the mechanisms by which potassium affects plant disease are not well understood.

Treatment (potash level) in kg/ha	AUDPC
30	40.25[a]
45	38.75[a]
60	28.75[b]
75	26.26[b]
90	25[b]
F-test	**
CV	14.1
SM	±3.18
LSD	6.93

Table 1: Effect of different doses of potash fertilizers on disease severity index of Alternaria leaf spot in Radish at Lamjung Campus, Lamjung, Nepal during October 2017 - January 2018.

Yield Parameters

Analysis was done in yield parameters (root length, root weight, plant height and root girth) and potash level and following result was found.

Treatments (Potash level)	Yield parameters			
	Plant height (cm)	Root length (cm)	Root girth (cm)	Root Weight (gm)
30 kg/ha	45.06[a]	28.30[b]	11.51[a]	268.9[b]
45 kg/ha	45.68[a]	29.78[b]	11.47[a]	287.3[b]
60 kg/ha	45.91[a]	30.03[b]	12.32[a]	318.9[b]
75 kg/h	46.95[a]	36.88[a]	13.77[a]	403.4[a]
90 kg/ha	47.38[a]	33.04[ab]	12.86[a]	380.2[a]
F-test	NS	**	NS	**
LSD	5.1	2.3	4.2	55
SE_m	±2.33	±4.92	±2.0	±25.24
CV%	7.1	10.1	21.8	10.8

Table 2: Effect of different doses of potash on yield parameters of radish at Lamjung Campus, Lamjung, Nepal during October 2017 - January 2018.

Plant height

The application of different levels of potassium had no significant effect on plant height of radish. Lowest plant height was found in plant receiving 30 kg/ha and highest at 90 kg/ha of MOP. Plant height with respect to potassium level was in increasing trend. This might be due to increase in nitrogen metabolism along with rise in potassium level which resulted in increased in high vegetative growth.

Root length

Root length differed significantly with increase in potassium dose. The longest root length was in the plant receiving 75 kg/ha of MOP (36.88 cm) which was statistically at par with 90kg/ha of MOP (33.04 cm) and shortest in 30 kg/ha of MOP (28.30 cm). The root length increased with increasing the level of potassium. Present findings are similar with Mahadevbhai (2007), About EINasr and Ibrahim (2011), Ali., *et al*. [15] and Hossain., *et al* [11]. Increased root length with high dose of potassium might be due to the potassium role in synthesis and translocation of carbohydrate, cell extension and increased nitrogen use efficiency.

Root girth

Non-significant result was obtained between root girth and potassium level. Lowest root girth was found in plant receiving 45 kg/ha and highest at 75 kg/ha of MOP. No trend was established in case of root girth.

Root weight

Significant result was obtained between root weight and potassium level. Maximum root weight was found in plant receiving the 75 kg/ha of MOP (403.4 gm) which was statistically at par with 90 kg/ha of MOP and lowest in 30 kg/ha of MOP (268.9 gm). There was increased in root weight with increase in potassium level which was congruent with the finding of Sarker [17]. Khatun., *et al.* (2001) found that increasing dose of potassium with certain level of nitrogen increase the yield. Both foliar application and soil applied potassium increase in yield parameters in low level of extractable potassium in soil [11], Kahlon., *et al.* [18] reported that with increase in potassium level onion bulb yield was increased and positive correlation was found between bulb yield and bulb diameter. The result is in harmony with those obtained by Balooch., *et al.* [19], Shibairo., *et al.* [20], Ali., *et al.* [15], EL-Bassiouny., *et al.* [21], Anjaiah and Padmaja [22], Bartaseviciene, and Pekarskas [23] and Hossain., *et al.* [16]. Noble Usherwood (1989) reported with 534 references that crops growth and yield were increased by 14% and 60% with increase in potassium level where soil potassium level was undefined. The increase in yield traits may be due to the superiority of vegetative growth parameters and N, P, and K accumulation of the treated plots, which could be attributed to the stimulatory effect of K on rate of photosynthesis and the its positive effect on stomata regulation, photosynthesis, translocation of nutrients, activation of enzymes and improved nitrogen efficiency transport of the photosynthetic product from the leaves to the storage root [24-29].

Conclusion

An investigation entitled "Effect of potash level on disease severity of *Alternaria* leaf spot in radish" Cv. Mino early was carried out in Horticultural farm of IAAS, Lamjung Campus during Octeber 2017 - December 2018 following the RCBD with 5 treatments (30, 45, 60, 75, 90 kg/ha of MOP) and four replications. Observations were taken on AUDPC, plant height, root weight, root girth and root weight. Highly significant effect of K was found in AUDPC and yield parameters (root weight and root length) and non-significant effect in root girth and plant height. Highest AUDPC was found at 30 kg/ha and lowest was found at 90 kg/ha of MOP. Maximum root length (36.88 cm), root girth (13.77 cm) and root weight (403.4 gm) was found at 75 kg/ha of MOP. Tallest plant height (47.38 cm) was found at 90 kg/ha of MOP. Minimum root length (28.30 cm), root weight (268.9 gm) and plant height (45.06 cm) was found at 30 kg/ha. A linear negative relation was found between root weight and AUDPC with medium level coefficient of determination. *Alternaria* leaf spot influenced the root weight by 51.3%. The negative relation between root length, root weight and root girth with AUDPC has been found.

From above findings, it can be concluded that 75 kg/ha of MOP is the best over other treatments in reducing the *Alternaria* leaf spot along with increasing yield.

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