PSM Biological Research
2017 | Volume 2 | Issue 2 | 74-78
ISSN: 2517-9586 (Online)

Science and Technology, Serving Society
PSM PUBLISHERS

www.psmpublishers.org

Research Article **Open Access**

Effect of Different Levels of Water Soluble NPK$_{(20\text{-}20\text{-}20)}$ Fertilizer on the Growth and Yield of White Radish (*Raphanus sativus* L.)

Imran Arshad*

Star Services LLC, Al Muroor Road – Abu Dhabi, United Arab Emirates.

Received: 10.Nov.2016; Accepted: 14.Feb.2017; Published Online: 28.Apr.2017
***Corresponding author: Imran Arshad; Email: engr_imran1985@yahoo.com**

Abstract
Fertilizers application plays a pivotal role in the production of vegetables and fruits. Too low or high fertilizers levels can reduce the growth and development process of plants which may affect the crop yield. To investigate the fact, a field experiment was carried out to check the growth and yield of radish on a sandy soil, under desert climatic conditions by using drip irrigation system. The field study was carried out on a randomized complete block design (RCBD) having nine different rates of water soluble NPK$_{(20\text{-}20\text{-}20)}$ fertilizer, i.e. (T_1 = control, T_2 = 0.25, T_3 = 0.50, T_4 = 0.75, T_5 = 1.00, T_6 = 1.25, T_7 = 1.50, T_8 = 1.75, and T_9 = 2.00) grams plant^{-1} fertigation^{-1} respectively. The results revealed that NPK$_{(20\text{-}20\text{-}20)}$ fertilizers with different rates brought a positive effect in radish cultivation. Amongst all the treatments, T_6 was observed to be more suitable and economical dose as it took the tallest radish plants (38.83 cm), highest number of leaves (20.74), highest leaves weight (260.12 g), highest root length (32.62 cm), maximum root diameter (11.06 cm), highest root weight (198.80 g), maximum total biomass (458.91 g) and maximum root yield (76.23 t/ha) respectively. However, control plots showed inadequate results regarding all the parameters. The application of NPK$_{(20\text{-}20\text{-}20)}$ (T_6 = 1.25 grams plant^{-1} fertigation^{-1}) was found suitable for the best possible growth and yield of radish under desert conditions. Application of fertilizers beyond this level seems to be an un-economical and wasteful practice.
Keywords: Radish, Fertigation, NPK Fertilizers, Drip Irrigation, Desert, Agriculture, UAE.

Cite this article: Arshad, I., 2017. Effect of Different Levels of Water Soluble NPK$_{(20\text{-}20\text{-}20)}$ Fertilizer on the Growth and Yield of White Radish (*Raphanus sativus* L.). PSM Biol. Res., 2(2): 74-78.

INTRODUCTION

Radish (*Raphanus sativus* L.) is an enormous vegetable to add your salad for a bit of colour and spice. Radish contains alkaline elements which help to digest food and cures constipation, beneficial for stomach pain due to gas, and to get rid of intestinal worms (El-Desuki *et al.,* 2005). Radishes are very much demanding throughout the year due to their health benefits, therefore its proper cultivation is essential in order to maintain the quality and fulfil the demand respectively. Cultivation involves several activities undertaken by farmers over a period of time. These activities or tasks are referred to as agricultural practices (Arshad, 2015b). Cultivation of radish involves; preparation of soil, sowing, adding manure and fertilizers, irrigation, protecting from weeds, harvesting and storage etc. The preparation of soil is the first step before growing radish. One of the most important tasks in agriculture is to turn the soil and loosen it. This allows the roots to penetrate deep into the soil. The process of losing and turning the soil is called tilling or ploughing (Arshad, 2015c).

Sowing is the most important part of radish production. Before sowing good quality seeds with high germination percentage should to be selected (Kashem, *et al.,* 2009). An appropriate distance between the seeds is important to avoid overcrowding of plants. This allows plants to get sufficient sunlight, nutrients and water from the soil. Addition of on time application of fertilizers to the soil is very much essential for the growth of plants (Arshad, 2015a). Too less or excessive dosage of fertilizers may negatively affect the quality parameters of radish. Generally, farmer's community uses inorganic fertilizers to gain more radish yield. Nitrogen improves the absorption & respiration process in plant and activates vegetation (Usman *et al.,* 2000). Radish plants with more leaves can give more root yield as compared to the plants having less leaves. Nitrogen is the main component of protein & chlorophyll. Deficiency of nitrogen turns the leaves yellowish, and results in low crop production. For the case of Radish production the phosphorus and potassium is required during the sowing time for sprouting of seeds, early maturation, transportation of photosynthesis products, and to increase the root size and diameter respectively (Djurovka *et al.,* 1997).

Water is important for the proper growth and development of root and leaves. Water is essential because germination of seeds doesn't take place under dry conditions (Jawad *et al.,* 2015). Nutrients dissolved in water get transported to each part of the plant. To maintain the moisture of the soil for healthy growth of radish, field have to be irrigated regularly as less water under hot climate makes the radish tough and bitter in taste. The frequency of irrigation varies from soil to soil, and season to season. In desert agriculture where water availability is poor, farmers are using drip irrigation system to irrigate their crops (Arshad *et al.,* 2014b). In this system, the water falls drop by drop just at the position of the roots. In field many other undesirable plants may grow naturally along with the radish. Tilling before sowing of the radish helps in uprooting and killing of weeds (Pandey, *et al.,* 1996). The picking of a radish after it is mature is called harvesting. In harvesting, radish is pulled out from the soil surface which usually takes 30-40 days depending upon the variety (Balouch *et al.,* 2014). The present research work was conducted to evaluate the effect of different levels of NPK $_{(20\text{-}20\text{-}20)}$ fertilizer on the growth and production parameters of radish.

MATERIALS AND METHODS

Location

The research work was carried out at a private farmhouse, in Liwa, Western Region of Abu Dhabi, UAE, in January 2016. The soil of the farmhouse was sandy in nature, with hydraulic conductivity (1.051×10^{-4} m/sec), bulk density (1.4 g/cm^3), and porosity (0.43) respectively. In order to increase the moisture holding capacity within the soil poultry manure was mixed with sand and irrigation was done through drip irrigation system respectively.

Field Experiment

The present research was carried out on a randomized complete block design (RCBD) having nine different rates of water soluble $NPK_{(20\text{-}20\text{-}20)}$ fertilizer, i.e. (T_1 = control, T_2 = 0.25, T_3 = 0.50, T_4 = 0.75, T_5 = 1.00, T_6 = 1.25, T_7 = 1.50, T_8 = 1.75, and T_9 = 2.00) grams plant^{-1} fertigation^{-1} respectively. Initially the seed bed was prepared by using traditional hoes and drip irrigation lines were installed for the irrigation purpose accordingly (Arshad *et al.,* 2014a). Small holes were dig adjacent to the emitters and 10 gram poultry mixture with sand along with equal amount $NPK_{(12\text{-}12\text{-}17)}$ was mixed and filled in to the holes and pre-irrigated accordingly. The plant to plant distance was kept 6cm and distance among lateral was kept 30cm respectively (Balouch *et al.,* 2014). Radish variety (Mino Early White) was used in this research and which was sown at rate of 3 kg per acre in January 05, 2016.

The $NPK_{(20\text{-}20\text{-}20)}$ fertilizer was applied to all the subplots throughout the research period on every alternate day and to maintain the moisture within the soil, water applied to the soil twice a day i.e. during morning and evening hours (Pamwar *et al.,* 2000). Furthermore, to maintain the root quality and early ripening calcium and manganese fertilizers are also applied in equal amount to all sub-plots on weekly basis. The first harvesting was done after 37 days from sowing date. Irrigation prior to picking was done to reducing root damage (Arshad *et al.,* 2015). In order to identify the best treatment ten plants from each of the treatments were tagged and data were recorded after harvesting. The agronomic parameters for the growth and yield characters studied were plant height (cm), number of leaves per plant, weight of leaves per plant, root length (cm), root diameter (cm), root weight plant 1 (g), total biomass (g), and root yield (tons / ha). Finally all the data analysis and statistical analysis were done through ANOVA procedure accordingly.

RESULTS AND DISCUSSION

A study was initiated to check the effects of different rates of water soluble $NPK_{(20\text{-}20\text{-}20)}$ fertilizer on the growth and yield of radish under sandy soil and desert climatic conditions. The subject study revealed that radish plant height, number of leaves, weight of leaves, root length, root diameter, root weight, total biomass, and root yield differed very significantly ($P<0.05$) between applications of different rates of water soluble $NPK_{(20\text{-}20\text{-}20)}$ fertilizer as mentioned in Table 1. The critical gathered observations and data for the above discussed parameters during the present study are appended below:

Plant Height

Statistically remarkable results were observed for plant height for all treatments as shown in Table 1. The maximum plant height (38.83 cm) was recorded for the treatment T_6 followed by T_5 (37.19 cm) respectively. While the minimum plant height (26.91 cm) was recorded for the treatment T_1 i.e. in control plot respectively. As plant height is an initial sign of vegetative growth therefore, on time and required application of $NPK_{(20\text{-}20\text{-}20)}$ fertilizer increases the soil fertility which results in healthy crop. Due to proper application of fertigation during root developing period the plants attain maximum height. While, minimum plant height was observed due to the unavailability of required amount of $NPK_{(20\text{-}20\text{-}20)}$ fertilizer, required by the plants during growth and development stages. These results are in agreement with (Jawad *et al*., 2015; Arshad *et al*., 2014c), who concluded that by increasing the rates of NPK fertilizer, the height of plant can also be increased for radish and capsicum green bell.

Number of Leaves

Statistically significant results were observed for number of leaves per plant for all treatments (Table 01). The maximum number of leaves per plant was observed for the treatment T_6 (20.74) followed by T_5 (20.13) and T_7 (19.93) respectively. Once again the minimum number of leaves was observed for the treatment T_1 (control) with (14.49) leaves per plant. The radish is a quick growing vegetable and requires appropriate amount of NPK fertilizers for its growth

especially when grown under desert condition where essential nutrients within the soil are very low for its growth and development. The plants attain maximum number of leaves may be due to the appropriate application of adequate amount of $NPK_{(20\text{-}20\text{-}20)}$ fertilizer, which produce healthy leaves for plant and results in enhancing the vegetative growth of plant respectively. While minimum numbers of leaves were observed in plants due to unavailability of essential nutrients, for the production of healthy leaves. The results were supported by the findings of (Jilani *et al*., 2010; Arshad *et al*., 2016), who concluded that number of leaves per plant can be increased with the application of appropriate amount of fertilizers needed by plants during its growth and development period.

Leaves weight

The maximum leaves weight per plant (260.12 gm) was observed for T_6, followed by T_5 (258.70 gm) and T_7 (256.11gm) whereas, minimum leaves weight per plant (143.68 gm) was observed in case of T_1, while, remaining treatments showed intermediate leaves weight (Table 1). The presence of sufficient amount of $NPK_{(20\text{-}20\text{-}20)}$ fertilizer, enhanced the soil fertility level and improves the plant growth, due to which the plants ultimately produce healthy leaves which increased the weight of the leaves per plant. The results are in agreement with the findings of (Parvez *et al*., 2003) who concluded that leaves weights increased by increasing the rates of NPK fertilizers in radish respectively.

Root Length

During the research study it had been observed that different rates of water soluble $NPK_{(20\text{-}20\text{-}20)}$ fertilizers, significantly affected the root length of radish. The maximum root length (32.62 cm) was obtained by treatment T_6, while the minimum root length (20.26 cm) was observed in T_1 i.e. control plots. The increase in root length is mainly depends on the environmental and agronomic factors, therefore the plants having more number of leaves have generally more root length. Likewise soil condition and texture also plays a critical role in enhancing the root length. Similar results were observed by (Bilekudari, *et al*., 2005; Arshad *et al*., 2015) who reported that root length of radish and carrot was found more in those plants which produced more number of leaves.

Root Diameter

Statistically significant results were observed for root diameter with maximum (11.06 cm) and minimum (8.30 cm) for treatment T_6 and in control (no fertilizer) respectively. These results showed that the root growth was increased with the increase in fertilizer dosage during growth period of the plant. However, over fertigation i.e. excessive fertilizers application starts decreasing the root length which is ultimately a non-economical and wasteful practice. These results are in agreement with (Arshad *et al*., 2015; Asghar *et al*., 2006) for carrot and radish, who observed that the root diameter increased with the increased in NPK fertilizers, however, it starts decreasing when the fertilizers treatment applied beyond its desired level.

Table 1. Effect of Different Rates of Water Soluble $NPK_{(20\text{-}20\text{-}20)}$ Fertilizer on Different Statistical Agronomic Parameters of Radish

Treatments	Plant Height (cm)	No. of Leaves per Plant	Leaves Weight per Plant (g)	Root Length per Plant (cm)	Root Diameter per Plant (cm)	Root Weight per Plant (g)	Total Biomass per Plant (g)	Root Yield t / ha
T_1 (Control)	26.91c	14.49c	143.68e	20.26e	8.30c	117.12f	260.79f	37.88c
T_2	31.66bc	17.05bc	169.03de	23.84d	9.77b	137.78e	306.82e	44.57b
T_3	34.04b	18.33b	181.76d	25.63c	10.50a	148.16d	329.91de	47.92ab
T_4	36.54a	19.07a	208.43bc	27.00c	10.59a	166.02bc	374.44cd	56.81a
T_5	37.19a	20.13a	258.70a	27.48b	10.85a	175.30b	434.00b	67.20a
T_6	38.83a	20.74a	260.12a	32.62a	11.06a	198.80a	458.91a	76.23a
T_7	36.91a	19.93a	256.11a	27.20b	10.74a	173.54b	429.66bc	66.53a
T_8	36.08a	18.72ab	240.59b	25.56cd	10.09a	163.03c	403.62c	62.50a
T_9	34.32ab	18.69a	204.26c	26.46bc	10.38a	162.70c	366.95d	55.67a
LSD (P<0.05)	3.86	2.03	7.87	2.91	1.14	6.52	6.88	23.50

* Means followed by different letter shows significant result at 5% level of significance.

Root Weight

During the research study it had been observed that different rates of water soluble $NPK_{(20\text{-}20\text{-}20)}$ fertilizers, significantly affected the root weight of radish. The maximum root weight per plant (198.80 g) was achieved in treatment T6 which was statistically similar with treatment T_5 and T_7 respectively. The minimum root weight per plant (117.12 g) was recorded in treatment T_1 (control). The high root weight per plant in radish may be due to on time, balanced fertilizers application along with proper plant spacing which produced healthy leaves and help plants to increase its roots size. Similar results were obtained by (Balouch *et al*., 2014) who reported that root weight of radish increased remarkably with the increase in NPK fertilizers rates upto 150-75-100 kg / ha.

Total Biomass

Statistically considerable results were observed for total biomass per plant which is the sum of weight of root and leaves of radish respectively. Once again the maximum (458.91 g) and minimum (260.79 g) biomass was recorded in treatment T_6 and T_1 (control plot) respectively. The total biomass of a plant is a factor that is directly influenced by number of leaves, leaves length, weight of leaves, root length, root diameter and root weight per plant respectively. The plants having more number of leaves and root weight will produce more biomass accordingly. The present results supported by the findings of (Akoumianakis *et al*., 2011), who reported that in sandy soil, balanced level of fertilizers can improves the soil structure and allows the plant to grow more leaves with good root size to produce higher biomass per plant.

Root Yield

The observed data showed that root yield was significantly affected by different rates of water soluble $NPK_{(20\text{-}20\text{-}20)}$ fertilizers for radish. The maximum (76.23 tons / ha) root yield was achieved for treatment T_1 followed by the treatment T_5 and T_7 respectively. Once again the minimum yield (37.88 tons / ha) was observed in treatment T_1 respectively. The root yield found high may be due balanced fertilizers level within the soil due to which soil fertility increased and supports the growth and root development of plants. Addition of sufficient amount of water soluble $NPK_{(20\text{-}20\text{-}20)}$ fertilizers improves the quantitative parameters of radish i.e. leaf and root weight which ultimately increased the yield. Similar results were obtained by (Arshad *et al*., 2015; Wachstum *et al*., 2002), who reported that balanced level of fertilizers can gave maximum carrot and radish root yield per hectare.

CONCLUSION

From the results obtained it could be concluded that the water soluble $NPK_{(20\text{-}20\text{-}20)}$ fertilizers with different rates brought a positive effect in radish cultivation under sandy soil conditions. Amongst all the treatments, T_6 was observed to be more suitable and economical dose as it took the tallest radish plants (38.83 cm), highest number of leaves (20.74), highest leaves weight (260.12 g), highest root length (32.62 cm), maximum root diameter (11.06 cm), highest root weight (198.80 g), maximum total biomass (458.91 g) and maximum root yield (76.23 t/ha) respectively. However, control plots showed inadequate results regarding all the parameters. Too low or high fertilizers levels may reduce the yield and yield parameters of radish. The application of $NPK_{(20\text{-}20\text{-}20)}$ (T_6 = 1.25 grams $plant^{-1}$ $fertigation^{-1}$) were suitable for best possible growth and yield of radish under desert conditions. Application of fertilizers beyond this level seems to be an un-economical and wasteful practice. As an area under study was sandy; therefore these suggestions are applicable for only sandy soils while the results may vary for other types of soil.

ACKNOWLEDGEMENT

We are thankful to anonymous reviewers for their value able suggestions to execute the experiment.

CONFLICT OF INTEREST

The authors declare that they don't have any conflicts of interest and are also not interested in competing with anyone.

REFERENCES

Akoumianakis, K.A., Karapanos, I.C., Giakoumaki, M., Alexopoulos, A.A., 2011. Nitrogen, Season and Cultivar affect Radish Growth, Yield, Sponginess and Hollowness. Intl. J. Plant Prod., 5(1): 1-10.

Arshad, I., Ali, W., Khan, Z.A., Bhayo, W.A., 2016. Effect of Nitrogen and Phosphorus on the Growth and Yield of Alfalfa (*Medicago sativa* L.) under Agro-Climatic Conditions of Tando Adam. PSM Biol. Res., 1(2): 74-77.

Arshad, I., 2015a. Integrated Application of NPK Fertilizers on the Growth and Yield of Guava (*Psidium guajava* L.) in Arid Region of Lower Sindh, Pakistan. Int. Res. J. Plant. Crop. Sci., 2(1): 019-023.

Arshad, I., 2015b. Impact of Integrated Application of NPK Fertilizers on Growth and Yield of Sapota (*Achras sapota* L.) under Agro-Ecological Zone of Gharo. Int. Res. J. Plant. Crop. Sci., 2(1): 015-018.

Arshad, I., 2015c. Effect of Different Levels of Fertilizers on the Growth and Yield of Cotton under Different Tillage Operations of Raja Plough (MB Plow). Int. J. Res. Appl. Sci. Eng. Tech., 3(5): 656-665.

Arshad, I., Khan, A.A., Babar, M.M., Sarki, A., 2015. Effect of Different Levels of Water Soluble NPK (20-20-20) Fertilizers on the Growth and Yield of Carrot (*Daucus carota* L.) by Using Drip Irrigation Technology. Int. J. Res. Appl. Sci. Eng. Tech., 3(5): 708-714.

Arshad, I., Babar, M.M., Irfan, M., Savona P., Ali, W., Farooqui, O., 2014a. Designing a Drip / Trickle Irrigation System by Using IrriPro Software (Case Study: Gharo Model Farm, Sindh – Pakistan). Int. J. Res., 1(11): 165-178.

Arshad, I., Ali, W., Khan, Z.A., 2014b. Effect of Different Levels of NPK Fertilizers on the Growth and Yield of Greenhouse Cucumber (*Cucumis sativus*) By Using Drip Irrigation Technology. Int. J. Res., 1(8): 650-660.

Arshad, I., Ali, W., Khan, Z.A., 2014c. Influence of Water Soluble NPK Fertilizers on the Growth and Yield of Greenhouse Pepper (*Capsicum annum* L.) by Using Drip Irrigation Technology. Int. J. Res., 1(11): 179-186.

Asghar, H.N., Ishaq, M., Zahir, Z.A., Khalid, M., Arshad, M., 2006. Response of Radish to Integrated Use of Nitrogen Fertilizer and Recycled Organic Waste. Pak. J. Bot., 38(3): 691-700.

Baloch, P.A., Uddin, R., Nizamani, F.K., Solangi, A.H., Siddiqui, A.A., 2014. Effect of Nitrogen, Phosphorus and Potassium Fertilizers on Growth and Yield Characteristics of Radish (*Raphinus sativus* L.). American-Eurasian J. Agric. & Environ. Sci., 14(6): 565-569.

Bilekudari, M.K., Deshpande, V.K., Shekargouda, M., 2005. Effect of Spacing and Fertilizer Levels on Growth, Seed Yield and Quality of Radish. Karnataka J. Agric. Sci., 18(2): 338-342.

Djurovka, M., Markovic. V., Ilin, Z., 1997. The effect of nitrogen fertilizer on the dry matter content and mineral elements in radish. Acta Hort., 46(2):139-144.

El-Desuki, S., Salaman, S.R., El-Nemr, M.A., Abdel-Mawgoud, A.M.R., 2005. Effect of plant density and nitrogen application on the growth, yield and quality of radish (*Raphanus sativus* L.). J. Agron., 4(1): 225-229.

Jawad, R., Nawaz, S., Hammad, H.M., Salik, M.R., Farhad W., 2015. Nitrogen and Sowing Method affect Radish Growth and Yield under Arid Environments of Pakistan. Sci. Int.(Lahore), 27(3): 2245-2250.

Jilani, M.S., Burki, T., Waseem K., 2010. Effect of Nitrogen on Growth and Yield of Radish. J. Agric. Res., 48(1): 1-7.

Kashem, M.A., Warman, P.R., 2009. Effect of Application of Chromium Feedstock Compost on the Growth and Bioavailability of Some Trace Elements in Lettuce. Comm. Soil Sci. Plant Anal., 40(1): 2426-2439.

Pervez, M.A., Ayyub, C.M., Iqbal, C.Z., Saleem, B.A., 2003. Growth and Yield Response of Various Radish (*Raphanus sativus* L.) Cultivars under Faisalabad Conditions. Pak. J. Life Soc. Sci., 1(2): 155-157.

Pamwar, A.S., Verma, V.S., Bawa, K., 2000. Growth and seed yield of radish as influenced by nitrogen and bio fertilizer application. Ind. J. Agron., 45(1): 411-415.

Pandey, U.C., Joshua, S.D., 1996. Effect of nitrogen levels and methods of planting on growth and yield of radish (*Raphanus sativus* L.). Hort. Absts., 58(2):983-989.

Usman, M., Ullah, E., Warriach, E.A., Farooq, M., Liaqat, A., 2000. Effect of Organic and Inorganic Manures on Growth and Yield of Rice Variety Basmati 2000. Int. J. Agric. Bio., 5(1): 481-483.

Wachstum, W.S., Rettich, E.S.V., 2002. Effect of Nitrogen Fertilization on Growth, Yield and Nitrogen Contents of Radishes. Int. J. Garten., 67(1): 23-27.