# EFFECTS OF SPACING AND PLANTING METHOD ON GROWTH AND YIELD OF RADISH (*Raphanus sativus*) UNDER CONTRASTING CONDITIONS OF DRY AND WET SEASONS


## Abstract

Radish (*Raphanus sativus*) is an edible vegetable root which is loaded with numerous health benefits due to its richness in nutrients, minerals, vitamins, folic acid, and anthocyanin. Inappropriate cultural practices, such as planting techniques and suitable plant populations, are causing a decline in radish productivity in Nigeria. Field experiments were conducted at National Horticultural Research Institute Research Farms during 2019/2020 rainy and wet seasons, to study the effects of spacing and planting pattern on growth and yield of radish (*Raphanus sativus*) under contrasting condition. Three spacings (10cm, 15cm, and 20cm) and two planting patterns (Direct sowing and transplanting) were investigated. The experiments were laid out in Randomized Complete Block Design (RCBD) with three replicates. The results revealed no significant differences for all studied traits at different spacing and planting method under dry and wet conditions. However, highest number of leaves per plant, plant height, and leaf length per plant were observed in 10cm in both direct sowing and transplanting under dry and wet seasons. Direct sowing at higher spacings (15cm and 20cm) gave highest canopy spread, tuber length, tuber diameter and tuber weight compared to transplanting under both seasons' conditions. Correlation showed significant positive associations of number of leaves per plant with leaf length and canopy spread while tuber weight showed significant positive correlations with tuber length and tuber diameter. The results of this study revealed that direct sowing at the spacing of 10cm under dry and wet seasons gave highest growth traits while 20cm provides high tuber yield of the radish.



Keywords: Radish, Growth, Spacing, Planting Methods.


## Introduction

Radish (*Raphanus sativus***)** is an edible vegetable root belonging to the family Brassicaceae which was domesticated in Asia in pre-roman times. Radish is grown and consumed throughout the world and being mostly eaten raw as crunchy salad (Annon, 2007). It is loaded with numerous health benefits due to its richness in nutrients, minerals, vitamins, folic acid, and anthocyanin and can treat skin ailments like dry skin. It is good source of antioxidants, antimicrobial, antibacterial activity to the body which ends in promoting overall health. Drinking radish juice helps to clean the kidneys and treats urinary health issues, weight loss and treat cancer.Like many vegetables, cultural practices such as inappropriate timing of dates of planting, plant population have been reported to reduce growth and yield in Radish. Lavanya *et al*. (2014) reported high root yield with 45cm x 10cm spacing, while El-Desuki *et al*.(2005) recorded maximum plant height and root yield of radish at 10cm x 20cm. Chaudhari *et al.* (2022) observed greatest growth and yield of Radish at 20cm Greatest growth and were also obtained by Parajuli *et al*, (2023). There is paucity of information about spacing and plant method of radish in Sudan Savannah Agro-ecological Zone of Nigeria under wet and dry conditions. There is need to furnish information on the effects of spacing and planting method on yield and growth of Radish under dry and wet conditions.

**Materials and Methods**

The experiments were conducted at National Horticulture Research Institute, Bagauda station, research farms in 2019 and 2020 rainy and dry seasons, respectively. The Experiments were laid out in a randomized complete block design (RCBD) and replicated three times with an alley of 0.5m between plots. Plot sizes consist of 6 ridges of 3m and 0. 75m apart. The treatments consisted of planting methods (direct sowing and transplanting) and spacing (10cm, 15cm and 20cm) which were randomly allocated to the plots. NPK fertilizer (15:15:15) at the rate of 80kgN/ha, 40kgP/ha and 60kgK/ha was splitted and applied at 2 and 4 weeks after sowing and transplanting. Weeding was conducted manually using

local hoe at 3 and 6 weeks after sowing and later supplemented with earthen up to support the crops rooting. Data were taken on number of leaves per plant, plant height, leaves length per plant, leave width per plant, canopy spread per plant, tuber length, tuber diameter, tuber weight. Harvesting was done manually after the tubers were matured. The data were analysed using STAR software 2.0.1(2014), while the correlations were determined using metan and lares packages in R.

**RESULTS AND DISCUSSION**

The effects of spacing and planting method on number of leaves per plant, plant height, leaf length per plant, leaf width per plant, canopy spread per plant, tuber diameter per plant, root length per plant and tuber weight per plant of radish under dry and wet seasons are presented in Table 1. No significant differences were observed for number of leaves per plant, direct sowing and transplanted at the spacing of 10cm recorded highest number of leaves per plant under dry and wet seasons (Table 1). Highest number of number of leaves per plant at 10cm spacing were observed by Lavanya *et al.* (2014). Direct sowing showed taller plants at 10cm spacing under dry season (Table 1) while taller plants were noticed at 20cm under wet season. The taller plants observed at lower spacing was because closer spacing increased plant density that limits the availability of space for lateral growth, resulting in increased plant height. Leaf length per plant recorded non-significant difference, however spacing of 10cm for direct and transplanting under both conditions revealed highest leaf length (Table 1). Direct sowing showed broad leaf width per plant at 10cm and 15cm under dry season, while transplanting recorded wider leaves at 15cm and 20cm under wet season. The results corroborate with the findings of Parajuli *et al.* (2023) who recorded significant highest plant height number of leaves per plant and leaf length per plant. It was observed that direct sowing and transplanted plants recorded wide canopy spread per plant at 10cm spacing under dry season, whereas transplanted plants revealed wider canopy spread at the spacing of 15cm and

20cm under wet season (Table 1). Radish is a long-day plant, which grow and flower when it receives more daylight than night. The highest canopy spread recorded under wet at both planting pattern was as results of longer daylength, and leaf length compared to dry season. Spacing of 15cm and 20cm revealed thicker tubers which were significantly high under direct sowing compared to the values recorded under transplanting method. Direct sowing also recorded longer tubers at all spacings compared to transplanting method under both seasons (Table 1). These results for thicker and long tubers observed at higher spacing were due to wide space for the tuber development and minimum competition for nutrients, sunlight and water. Regarding tuber weight per plant, there was no significant difference between treatments, however, direct sowing at 15cm and 20cm spacings revealed tuber weight per plant than transplanted plants. This is because the direct-sown plants have already established strong roots in the field for a month prior to the transplantation of seedlings. The results conform with the findings of Sahu *et al*. (2018) who reported that maximum length of root, diameter of root and root yield were observed at spacing of 40x15cm and direct sowing.

Table 1: Effect of spacing and planting pattern on growth and yield of Radish during 2019/2020 dry and rainy seasons conditions.

| | | NLPP | | PHT | | LLPP | | LWPP | |
|---|---|---|---|---|---|---|---|---|---|
| Season | spacing | direct | transplanting | direct | transplanting | direct | transplanting | direct | transplanting |
| Dry | 10cm | 24.82 | 17.30 | 26.10 | 25.82 | 19.86 | 28.47 | 10.62 | 8.95 |
| | 15cm | 18.71 | 9.69 | 20.32 | 20.48 | 16.44 | 16.42 | 14.85 | 7.39 |
| | 20cm | 15.93 | 11.85 | 21.12 | 23.46 | 12.78 | 11.91 | 6.55 | 7.09 |
| Wet | 10cm | 21.44 | 25.11 | 31.46 | 24.25 | 22.30 | 17.73 | 9.82 | 7.13 |
| | 15cm | 13.77 | 13.33 | 43.35 | 25.28 | 16.08 | 17.81 | 6.54 | 14.72 |
| | 20cm | 15.44 | 15.66 | 25.24 | 36.74 | 16.54 | 15.99 | 7.69 | 12.97 |
| Mean | | 16.92 | | 26.97 | | 17.70 | | 9.53 | |
| CV (%) | | 50.32 | | 4.21 | | 45.62 | | 66.60 | |
| SE± | | 6.95 | | 14.14 | | 6.59 | | 5.18 | |
| Interaction | | ns | | ns | | ns | | ns | |

NLPP: Number of leaves per plant, PHT: Plant height, LLPP: Leave length per plant, and LWPP: Leave width per plant

Table 1 continued.

| | | CNS | | TD | | T L | | TW | |
|---|---|---|---|---|---|---|---|---|---|
| Season | spacing | direct | transplanting | direct | transplanting | direct | transplanting | direct | transplanting |
| Dry | 10cm | 32.76 | 30.82 | 33.05 | 40.09 | 20.41 | 18.99 | 0.16 | 0.31 |
| | 15cm | 29.18 | 25.18 | 46.79 | 28.21 | 24.18 | 21.92 | 0.28 | 0.24 |
| | 20cm | 27.47 | 25.78 | 57.22 | 34.31 | 22.80 | 20.33 | 0.32 | 0.41 |
| Wet | 10cm | 15.33 | 28.99 | 36.05 | 39.09 | 20.49 | 18.69 | 0.23 | 0.18 |
| | 15cm | 31.63 | 29.48 | 46.96 | 30.77 | 23.16 | 22.55 | 0.30 | 0.27 |
| | 20cm | 34.27 | 31.38 | 56.18 | 33.94 | 22.39 | 19.33 | 0.34 | 0.17 |
| Mean | | 32.19 | | 40.22 | | 21.27 | | 0.27 | |
| CV (%) | | 41.24 | | 22.53 | | 19.72 | | 69.47 | |
| SE± | | 10.84 | | 7.40 | | 3.43 | | 0.15 | |
| Interaction | | Ns | | ns | | ns | | ns | |

CNS: Canopy spread, TD: Tuber diameter, TL: Tuber diameter and TW: Tuber weight.

**Correlations**

The associations between growth and yield traits under contrasting condition are presented in figure 1. Significant positive correlations were observed between number of leaves per plant and leaf length per plant (0.40) and canopy spread (0.33). Canopy spread revealed significant positive associations with number of leaves per plant (0.33), leaf length per plant (0.38) and plant height (0.40) indicating that canopy spread increases with an increase of number of leaves per plant, leaf length per plant and plant height (figure 1). Tuber length showed highly significant positive correlation with tuber diameter (0.49) while tuber weight indicated significant positive associations with tuber length (033) and tuber diameter (0.33). Significant positive correlations recorded between tuber weight, tuber length and tuber diameter revealed that tuber weight increases as the length and diameter of the tuber increase. Thakur *et al*. (2023) reported significant positive correlations of tuber weight with tuber length, but significant negative association was recorded with tuber diameter. Significant positive correlation were reported on tuber weight and tuber diameter (Kamal and Esraa, 2022 and Dongarwar *et al*., 2024). Ranked cross-correlations was determined to rank the highest correlation among growth and yield traits obtained in a cross-table. The results revealed highest associations in descending order tuber diameter + tuber length > number of leaves per plant + leaf length> plant height + canopy spread > leaf length + canopy spread > number of leaves per plant + canopy spread > tuber diameter + tuber weight > tuber length + tuber weight > plant height + leaf length. The results indicated that selection of one trait will lead to an increase of its associated trait (figure 2).

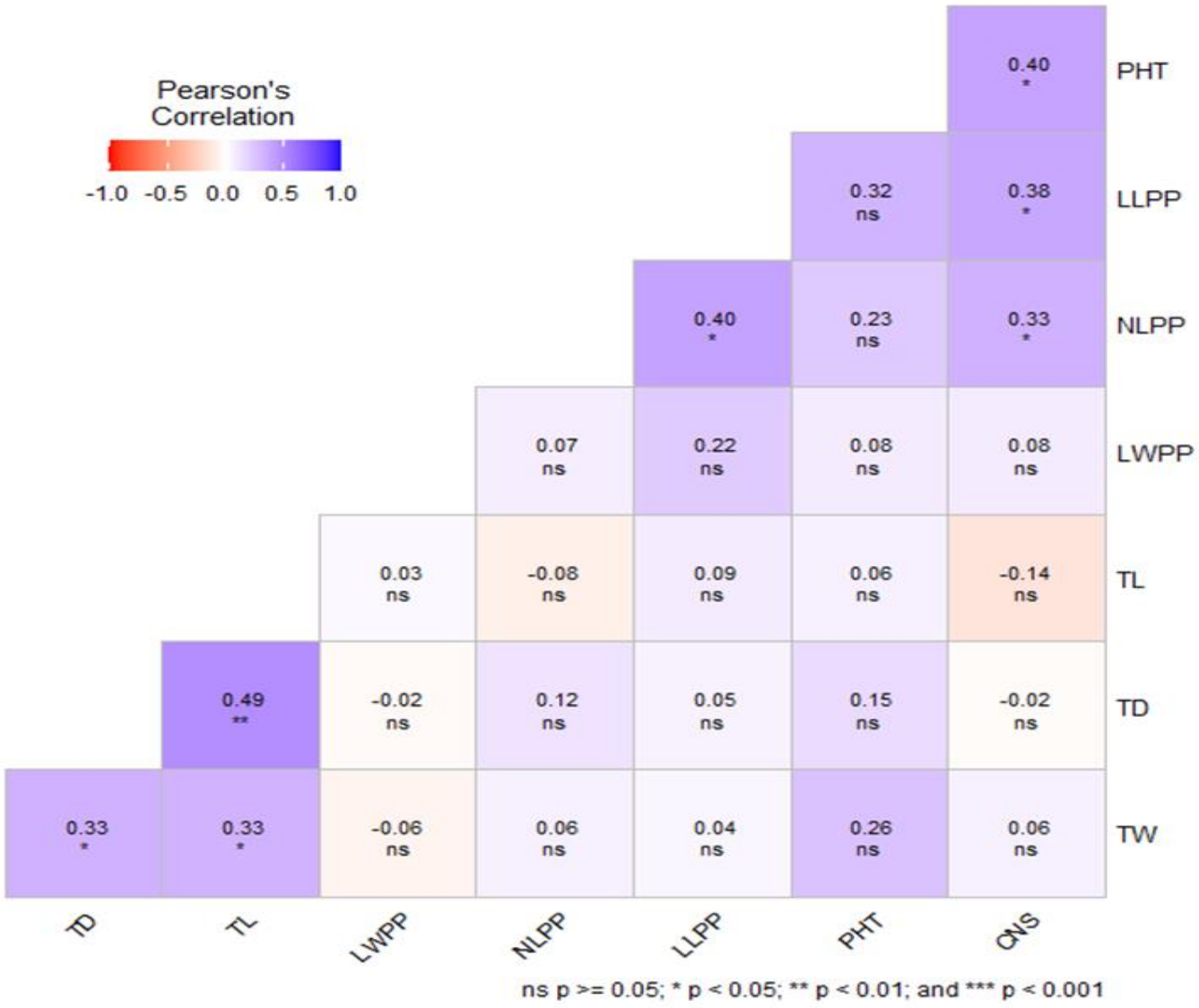


Figure 1: Pearson's correlations of growth and yield traits of radish under rainy and wet season conditions. NLPP: Number of leaves per plant, PHT: Plant height, LLPP: Leave length per plant, LWPP: Leave width per plant, CNS: Canopy spread, TD: Tuber diameter, TL: Tuber diameter and TW: Tuber weight.

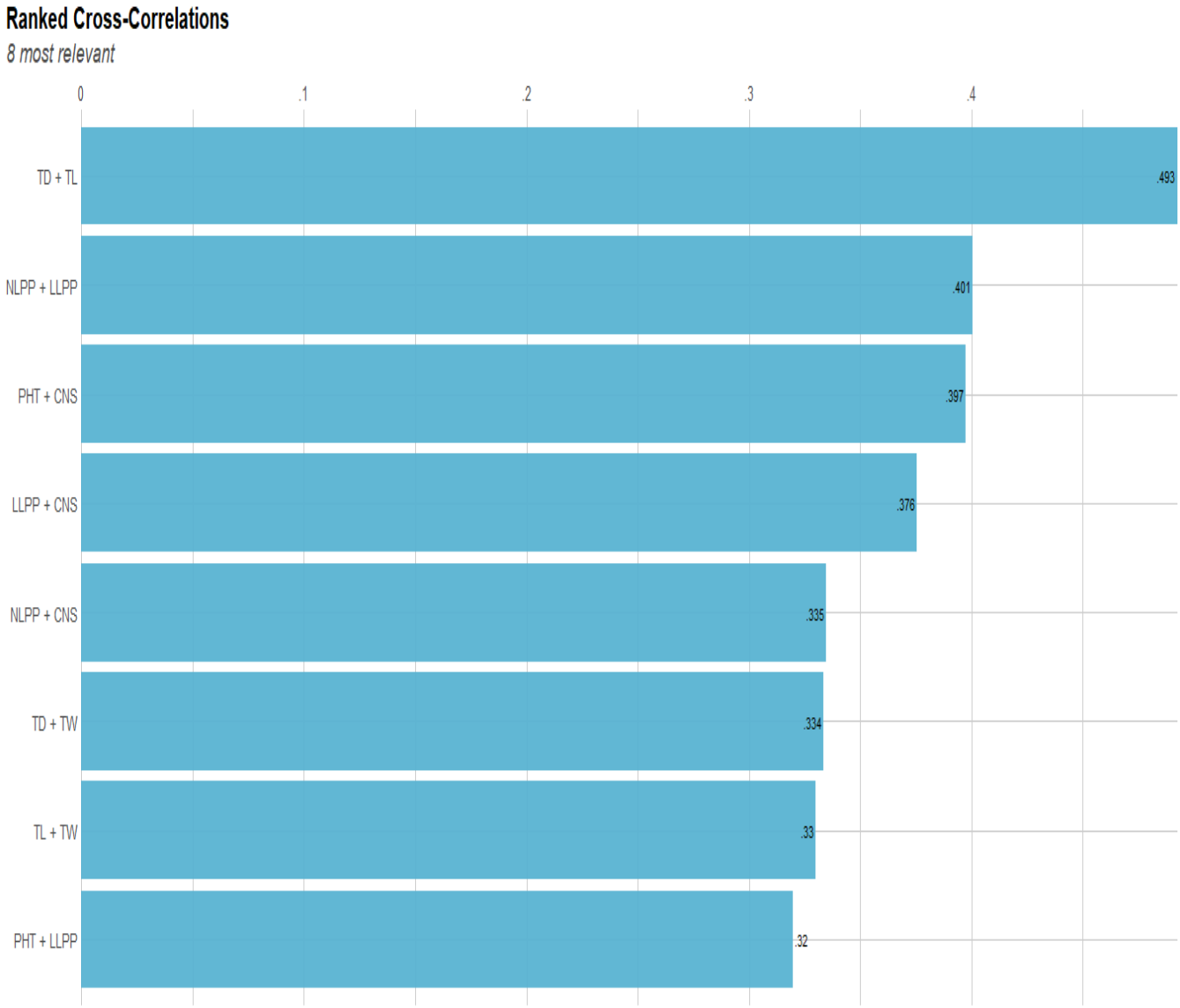


Figure 2: Ranked cross-correlations of growth and yield traits of radish under rainy and wet season condition. NLPP: Number of leaves per plant, PHT: Plant height, LLPP: Leave length per plant, LWPP: Leave width per plant, CNS: Canopy spread, TD: Tuber diameter, TL: Tuber diameter and TW: Tuber weight.

**Conclusions**

Based on the results of this study, it is suggested that direct sowing at the spacing of 10cm under dry and wet seasons gave highest growth traits while 20cm provides high tuber yield of the radish. The results of correlations showed that tuber length and tuber diameter were determinant of tuber yield in radish.

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