The effect of seed size, seed-root size, NPK, fertilizer placement, spacing, micronutrients and growth regulators on the growth and fruiting of radish seed crop based on a 2-year study at the College of Agriculture, Ludhiana (Punjab) have been reported and discussed.

**Seed Size**

Mean germination percentage for the sorted large, medium and small radish seed in sand was 87.8, 86.3 and 54.0 per cent during the first year with negligible variation in the second year.

The germination percentage as obtained on blotters for the three size grades was relatively high, particularly in case of small seed.

Germination rate of large and medium seed was quicker than the small seed.

The large seed produced the highest fresh weight and the edible portion per plant. On the average, large, medium and small seed produced a mean root fresh weight of 229.7, 100.6 and 64.9 gm, respectively. The length and girth of the fresh root also varied accordingly.

The roots produced from large seed were the most succulent as the moisture content of roots from large seed was the
roots produced from medium and small seeds, respectively.

The effects of seed size on various characters observed during the second year were very similar.

**Seed-Root size**

Increase in seed-root length from 5 cm to 20 cm as well as the increase in seed-root girth from 12 cm to 18 cm progressively improved the final plant height. Seed-roots longer than 20 cm were attended by some decline in height.

There was an interaction between seed-root length x seed-root girth, meaning that the difference in plant height between 12 cm and 18 cm seed-root girth with 10 cm seed-root length was larger than that with 5 cm seed-root length. This interaction was due mainly to the original seed-root volumes for the four treatment combinations of seed-root length and seed-root girth.

Other growth characters like leaf number, primary branches and total branches per plant were similarly affected as the plant height by various treatments of seed-root length and seed-root girth, but the interaction value was not well marked in any case.

Total dry matter produced with 12, 15 and 18 cm seed-root girth was 5377, 6243 and 7605 kg/ha, respectively. The larger difference in dry matter between 15 cm and 18 cm seed-root girth as compared with that between 12 cm and 15 cm is
attributable to the initial differences in seed-root volume.

Mean dry matter for 5, 10, 15, 20 and 25 cm seed-root length was 1908, 6817, 7314, 8334 and 7666 kg/ha, respectively.
The largest difference in dry matter between 5 cm and 10 cm seed-root length and the interaction of these two treatments with seed-root girth could again be ascribed to the initial differences in the seed-root volume.

During the second year of the trial, similar results were obtained from various treatments though the total growth status of the plant was almost half due to the heavy infestation of aphids (Lipaphis erysimi).

Fruiting characters like flowers per plant, pods per plant, pod length, 1000-seed weight and seed yield per plant showed similar treatment effects as in case of growth characters except for some variation in the value of interaction effect between seed-root length and seed-root girth.

During the second year, similar trends were observed except that the effect of seed-root girth on setting percentage, mean pod length and 1000-seed weight were not statistically significant.

The percentage of immature seeds in radish crop was less than one per cent. This value varied within small limits with variation in the length and girth of seed-root.

Mean seed yield for 12, 15 and 18 cm seed-root girth was 1457, 1728 and 2112 kg/ha, respectively in the first year.
Evidently, yield increase was more with increase of seed-root girth from 15 cm to 18 cm than from 12 cm to 15 cm. For seed-root lengths of 5, 10, 15, 20 and 25 cm, the mean seed yields were 453, 1890, 2026, 2320 and 2140 kg/ha, respectively.

The yield trends noticeable under various treatments of seed-root girth and seed-root length, including even the interaction between these two factors, were more or less similar to those discussed under plant height. Most of these variations were accountable to the initial differences in seed-root volume.

During the second year, increase in seed-root length from 10 cm to 20 cm did not show any favourable effect on seed yield. Besides, increase in seed-root length from 20 cm to 25 cm was attended by increased seed yield, unlike the decline noticed in the previous year.

The analysis of soil for bulk density and penetration load revealed that the field under experiment in the second year had a ploughpan resulting in increasing bulk density up to 1.62 gm cm$^{-3}$ in the zone of the longest seed-root. The penetration load for the 5 cm core also rose from 0 to 3.8 kg with increasing soil depth to 25 cm. This impediment in the way of proper growth of seed-root consequently restrained the improvement of seed yield.

It is interesting to note that seed-yield proved more sensitive to ploughpan than plant growth.
NPK and Spacing

All the three nutrients applied at 0.50 and 100 kg/ha each increased final plant height, but the effect of nitrogen was the most pronounced. The mean plant height for 0, 60 and 100 kg N/ha was 115.0, 126.3 and 128.6 cm, respectively.

Wider rows i.e. 90 and 120 cm apart, as compared with rows 60 cm apart, reduced plant height though the average space around individual plant increased with each increase in row spacing. Free air movement, branching load and high light incidence were considered responsible for this dwarfing effect of wide spacing. Nitrogen in combination with narrow rows particularly increased the plant height. During the second year, only nitrogen and row spacing produced significant effects on height.

Leaf number, primary branches and total branches per plant were also favourably affected by nitrogen and wide row spacing.

Dry matter produced with 0.50 and 100 kg N/ha was 4526.7, 714 and 8714 kg/ha, respectively during the first year. P and K also produced substantial positive effects.

Average dry matter production under 60, 90 and 120 cm wide rows was 8248, 6739 and 5957 kg/ha, respectively.

The significant interactions in dry matter were N×P, N×K, N×S and P×S, implying that P and K were more effective under higher levels of nitrogen, and nitrogen under closer row spacings.

Flowers per plant, setting percentage, pods per plant, pod length, seeds per pod and 1000-seed weight were favourably influenced by N, P and wide row spacing during both the years. The effects of N and wide row spacing were most pronounced.

Mean seed yield with 0.50 and 100 kg N/ha was 929, 1623 and
1986 kg/ha, respectively. With 0.50 and 100 kg P₂O₅, the corresponding yields were 1153, 1529 and 1801 kg/ha. Potsesh, too, showed similar, but smaller effects. Seed yield for 60, 90 and 120 cm wide rows was 1797, 1537 and 1148 kg/ha, respectively.

The significant linear components of interactions on seed yield were NₓP (348 kg/ha), NₓS (-141 kg/ha) and PₓS (144 kg/ha). These implied that the effect of nitrogen was enhanced by P, K and close row spacing.

Barring the favourable effects of K and NₓK, the results of the second year were similar to those of the first year.

The percentage of bold seeds in the produce increased from 91.4 to 97.8 with increase in the dose of nitrogen from 0 kg to 100 kg N/ha. P showed a small effect on this character and K none. Wide row spacings also increased the ratio of bold seed to total produce from 94.3 to 96.3 per cent.

The coefficient of determination (R²) was 0.9900 when the linear, quadratic and first order interactions of NPK were taken into account.

If only the linear effects of NPK under 60 cm wide rows were taken into consideration, the coefficient of determination (R²) was reduced to 0.8542. This difference is due to the omission of quadratic components of N and P and the interaction NₓP which have significant values.

Assuming the rate per kg of N, P₂O₅ and K₂O as Rs. 2.61, Rs. 2.69 and Rs. 0.94, respectively inclusive of the application cost, and the price of produce at Rs. 3.25 excluding the collection charges, the optimum dose of N, P₂O₅ and K₂O worked out to 122, 210 and 122 kg/ha respectively. It was not possible to calculate the optimum dose of
N, P and K for the second crop season as the quadratic components of their response were too small.

**Fertilizer Placement**

The five fertilizer placement treatments were:
(a) Local Practice, (b) Fertilizer on one side of the seed-root, (c) Fertilizer and seed-root in the same row, (d) Fertilizer in split dose on either side of the seed-root and (e) Hill Placement.

In the ultimate analysis, the best treatment proved to be the 'Hill Placement' with insignificant differences from treatments (c) and (d) above.

The mean seed yields for the above five treatments were 349, 359, 393, 991 and 1042 kg/ha (C.E. 5% 48 kg), respectively. The yield differences in these treatments were due to the deep placement of fertilizer and its better distribution in the root zone.

**Micronutrients**

Spray application of borax (1 kg/ha), ferrous sulphate (2 kg), ammonium molybdate (1 kg), zinc sulphate (2 kg), copper sulphate (2 kg), manganese sulphate (2 kg/ha) and complete mixture of all micronutrients twice during the crop season (50 days and 60 days after planting) failed to influence the growth and yield of radish seed crop. Of the two fertility levels (F₁ = N₉₀₀ P₅₀ K₅₀ and F₂ = N₁₅₀ P₁₅₀ K₇₅/ha), the higher level significantly depressed both growth and fruiting. There were no interactions between the fertility level and micronutrients.

**Growth Regulators**

Treatment of seed-root with IBA, NAA and their mixture (50:50) in concentrations ranging from 100-1600 ppm just before planting showed no effect at all on the growth and yield of radish seed crop. It is surmised that a quick growing crop like radish is naturally endowed with the needed hormone complex.

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