INVESTIGATION OF NITROGEN LEVELS AND ROW SPACING ON GROWTH AND YIELD OF MUSTARD CROP VARIETY VNR 509: A CASE STUDY

Abstract:
This case study investigates the effect of different combinations of nitrogen levels and row spacings on the growth and yield of the mustard crop (variety VNR 509). The experimental trial were conducted during the rabi season on the farming land at ASPEE agricultural research and development foundation (ARDF), located in the north Konkan region of Maharashtra, India.
A well-formulated combination of treatments has been applied in a factorial randomized block design (FRBD) with three replications. The results indicate a significant influence observed with a specific dose of nitrogen (90 kg N per hectare) applied at particular row spacing (45 cm x 10 cm) on plant growth and yield. A higher dose of nitrogen and wider row spacing have been shown to increase plant height, promote branch development, and result in a higher number of seeds per siliquae. However, a trend was noticed, as a decrease in row spacing led to a higher number of pods per plant. These findings would be helpful while selecting an appropriate approach for cultivation of many other similar crops, achieving higher yields, and maintaining crop quality.

Keywords: Nitrogen, Mustard, Fertilizer, Crop protection equipment, North Konkan.

INTRODUCTION

The consistently rising demand of edible oil may significantly affect the economics of trading policies on the export-import of a country. In India, the consumption of edible oil is around 23.46 million metric tons (MMT), with an estimated average consumption of 16 kg per person. It is now predicted that the consumption may reach up to 30 million tons by 2025 (Govt of Telangana) [1]. The import of edible oils during the first eleven months of the 2022-23 oil year has surged to 154.69 lakh tonnes (SEA) [2].
India has vast potential to promote the cultivation of oilseeds crops. Among all sources of edible oils, after soybean, mustard is the largest crop cultivated in India. Its production was 128.2 lakh tonnes out of 400 lakh tons of oilseeds during 2022-23, contributing to 32.2% of the total oilseeds (Govt of India Press release) [3]. Leading cultivating states are Rajasthan, Haryana, Uttar Pradesh, Punjab and West Bengal (Rathi et al 2019) [4].
Mustard (Brassica juncea) is a popular and economically grown crop known for its rich source of cooking oil seeds. These seeds are richly nutritive ingredients, 38-57% erucic acid, 5-13% linoleic acid and around 27% oleic acid. They are also good carriers of antioxidant vitamins A, D, E and K. (Sai et al 2022) [5]. The oil content in mustard seeds generally ranges from 37 to 49 % (Bhowmik et al 2014) [6].
The present study is intended to highlight two crucial factors: nitrogen levels and row spacing, which greatly influence mustard growth and yield. Nitrogen is an essential nutrient for plant development, and row spacing affects plant density and, consequently, crop architecture.
The structure of the paper delves into subsequent sections describing the materials and methodology, statistical analysis of data, discussion on results, and finally, a conclusion.

MATERIALS AND METHODOLOGY:

The experimental were conducted during the rabi season on the farming land at ASPEE agricultural research and development foundation (ARDF), located in the north Konkan region of Maharashtra, India. The experimental setup involved the cultivation of mustard variety VNR 509 in a factorial randomized block design (FRBD) with three replications as given in Table 1. In a FRBD layout, the study involves more than one independent variable, and each level of one independent variable is combined with each level of the other independent variables. The study investigated four levels of nitrogen application (N1: 30 kg/ha, N2: 60 kg/ha, N3: 90 kg/ha, N4: 120 kg/ha) and two row spacing

configurations (D1: 30 x 10 cm, D2: 45 x 10 cm). It is given in Table 2 and Table 3. Experimental data were recorded during course of experiment on various parameters, including plant height, number of branches per plant, number of pods per plant, length of pods, number of seeds per pod, test weight, and seed yield as given in Table 4.

Table 1: Experimental details

Particular	**Details**
Crop:	Mustard
Variety:	VNR 509
Sowing date:	30/01/2023
Experimental Layout:	Factorial Randomized Block Design (FRBD)
Plot Size:	5.0 X 2.4 m
No. of Replication:	3

Table 2: Treatment Details:

Nitrogen levels		**Row Spacing**	
N1	30 kg N per ha	D1	30 x 10 cm
N2	60 kg N per ha	D2	45 x 10 cm
N3	90 kg N per ha		
N4	120 kg N per ha		

Table 3: Treatment Combination:

Treatment	**Action**
T1	30 kg N per ha + 30cm x 10 cm
T2	30 kg N per ha + 45cm x 10 cm
T3	60 kg N per ha + 30cm x 10 cm
T4	60 kg N per ha + 45cm x 10 cm
T5	90 kg N per ha + 30 cmx 10 cm
T6	90 kg N per ha + 45cm x 10 cm
T7	120 kg N per ha + 30m x 10 cm
T8	120 kg N per ha + 45cm x 10 cm

STATISTICAL ANALYSIS

The results of the study are presented in Table 4, showing the effects of nitrogen levels and row spacing on the various parameters observed. The recorded data exhibiting different characteristics were subjected to statistical analysis of variance (ANOVA) and generated different regression models depicting the pattern of seed yield in response to the certain variables as shown in figures 1 to 4. Critical difference (CD) values and standard error (S.Em.±) have also been calculated. For instance, a larger standard error suggests greater variability in the sample mean.

Table 4: Data showing the effects of nitrogen levels and row spacing on mustard growth and yield

Treatment	**Plant height (cm)**	**No. of branches per plant**	**No. of siliquae per plant**	**Length of siliquae**	**No. of seeds per siliquae**	**Test weight (g)**	**Seed Yield (kg/ha)**
T 1	94.28	7	10.3	2.84	9	4.07	1361.2

T 2	97.25	7.5	12.1	3.2	10.1	4.97	1686.2
T 3	99.88	8	13.3	3.4	10.7	5.61	1967.7
T 4	100.94	8.7	14.3	3.68	11.4	5.86	2108
T 5	103.71	9.5	17.6	4.06	12.4	6.18	2260.6
T 6	108.11	10.5	21.7	4.5	14	6.78	2532.5
T 7	101.79	9.1	16	3.91	11.8	6.06	2200.5
T 8	104.59	10	20.1	4.21	13.3	6.35	2388.6
S.Em.±	0.27	0.07	0.18	0.02	0.11	0.02	19.1
CD	0.81	0.22	0.55	0.08	0.34	0.05	57.66

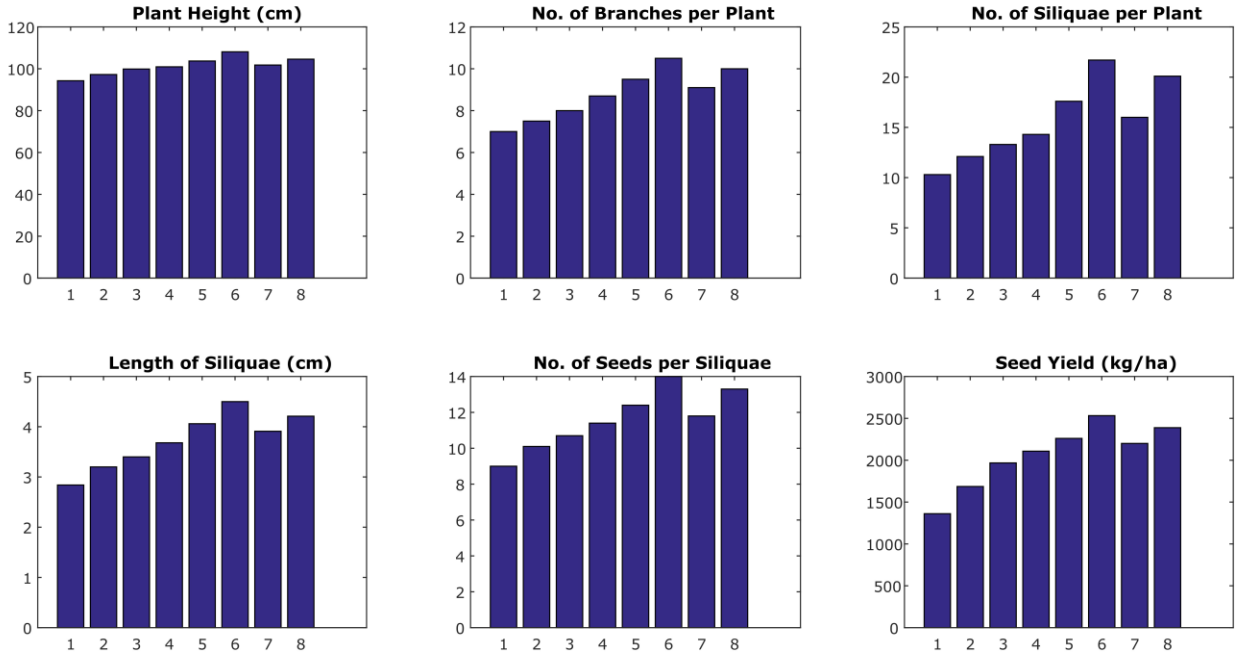

Figure 1: Illustrative effect of treatments on variable parameters of plant

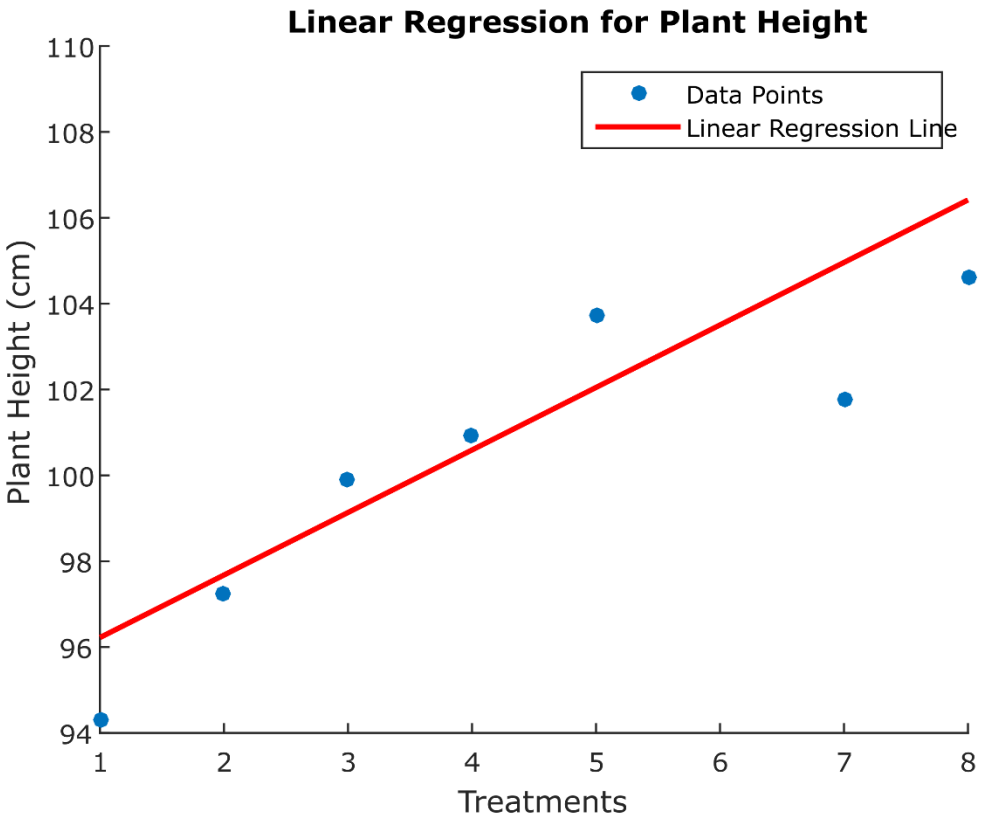

Figure 2: Linear regression line of plant height with treatments

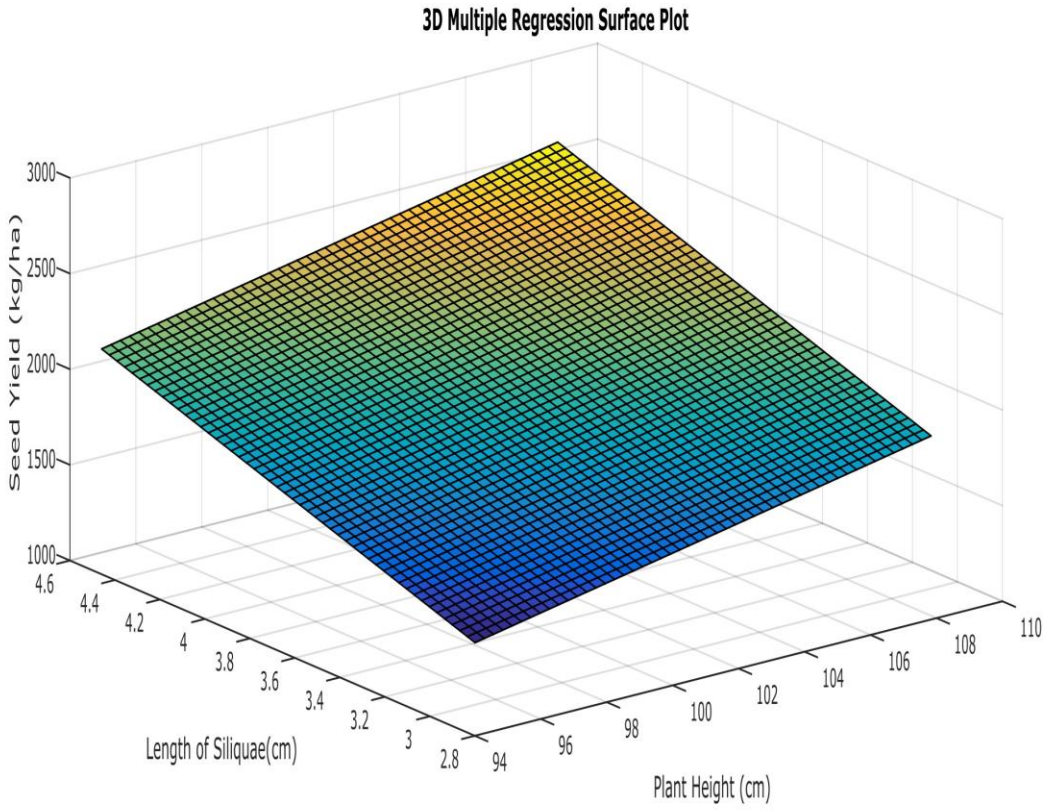

Figure 3: Regression surface plot of length of siliquae and plant height on seed yield

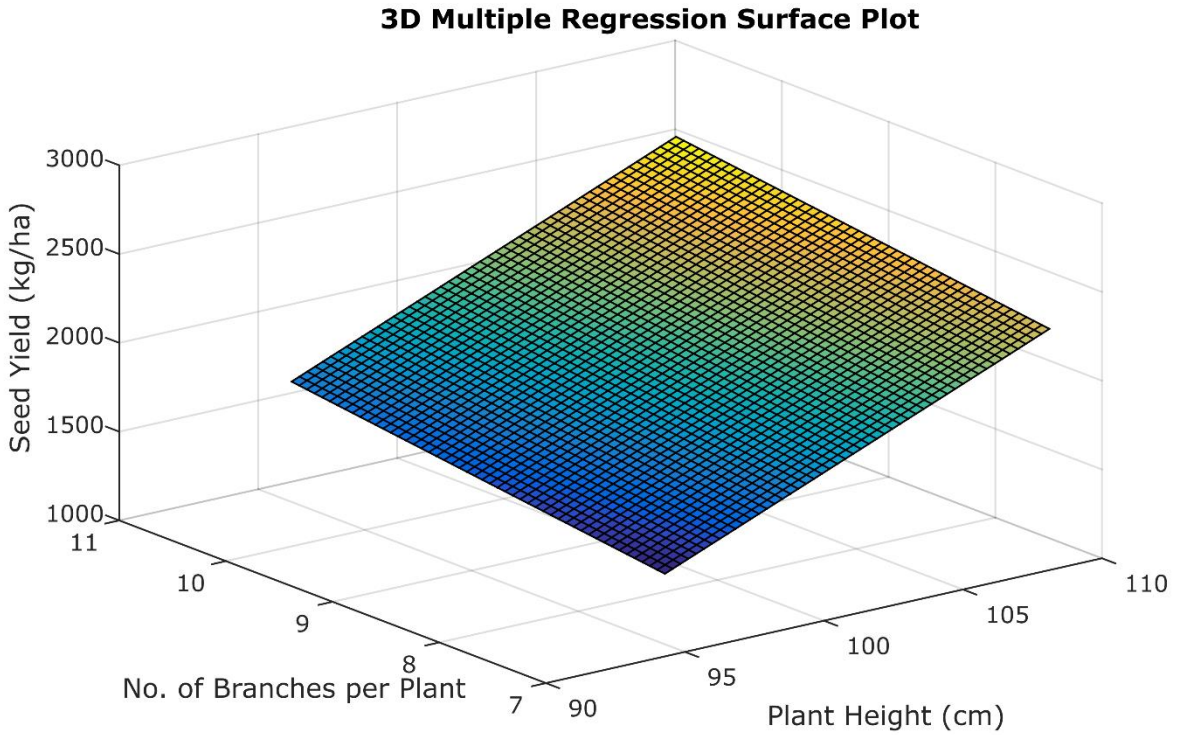

Figure 4: Regression surface plot of no. of branches per plant and plant height on seed yield

DISCUSSION:

Plant height

The obtained results show that the highest plant height was recorded with treatment of 90 kg N per ha with row spacing 45cm x 10cm (T6). The increased spacing probably helped in getting more sun light, nutrients and water, while reducing competition of inter and intra plants. Similar observations have also been seen by Dabi et al. (2015) [7], Rameti et al., (2017) [8] and Sai et al (2022) [5].

Branches/plant

The larger plant spacing, at 45 cm x 10 cm between plants, provides more sunlight, soil moisture, and nutrients, leading to increased photosynthesis, metabolic activities, and overall growth and development, which results in a higher number of branches. Similar finding was also found by Gadade et al. (2018) [9] in groundnut.

Yield: Siliquae/plant and Yield

Treatment T6 exhibits the significant number of siliquae per plant (21.7), It may probably due to better photosynthetic activities by sufficient light and balanced nutrient supply during growth stages. These ultimately results into a significant and appreciable yield to 2532.5 Kg/ha. Keivanrad and Zandi (2012) [10], Duval et al. (2015) [11] and Anjana et al., (2020) [12] found similar outcomes.

The above discussion revealed that selecting appropriate treatments with increased nitrogen levels and wide row spacing plays a significant role in mustard growth and yield.

Further research can explore additional factors and provide recommendations for promoting mustard farming.

CONCLUSION:

The results of experiments carried out at ASPEE foundation highlighted that nitrogen levels and row spacing have significant roles on influencing the growth and yield of mustard variety VNR 509. The results also emphasize the need for establish a balance between the use of fertilizers to achieve the desired yield of mustard oil seeds and oil quality in terms of nutritional values. As mustard farming continues to evolve, these findings offer valuable insights for optimizing crop production.

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