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Effect of Sowing Dates on Yield and Economics of Indian Mustard (*Brassica juncea* L.) Varieties under Late Sown Conditions

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A B S T R A C T

A field experiment was conducted during *rabi* season of 2019, at crop research farm of Department of Agronomy at Sam Higgin bottom University of Agriculture, Technology and Sciences, Prayagraj with the objective to study the effect of sowing dates onyield and economics of Indian mustard (*Brassica juncea* L.) varieties under late sown conditions. Experiment comprises of 9 treatments replicated thrice. With 3 different dates of sowing 5th December, 10th December, and 15th December; 3 varieties *i.e.*, Varuna, Mahyco Bold, Pioneer. Maximum grain yield (2.60 t/ha), straw yield (5.32 t/ha) was recorded with the treatment no.1 Varuna + 5th December sowing. However, maximum gross return (104 x 10^3 ₹ /ha), net return (71.62 x 10^3 ₹ /ha), and Benefit: Cost ratio (2.2) was recorded with the treatment no.1 Varuna + 5th December sowing.

Introduction

Indian mustard (*Brassica juncea* L.) belonging to the family Cruciferaeis. One of the chief winter oilseed with a major source of high quality of edible oil (37- 49%).Mustard is the third important oilseed crop in the world after soybean (*Glycine max* L.*)* and palm (*Elaeisguineensisjacq)* oil. It is grown in sub-tropical and tropical countries in the world. Oilseed cultivation is undertaken across the country in about 26.00 million ha, covering 72% under rain fed areas and producing around 30.00 million tons of oil seed.

Out of the nine major oilseed crops grown in India, soybean (39%), Groundnut (26%) and Mustard (24%) add more than 88% of total oilseed production in the country. Indian mustard is mainly cultivated in Uttar Pradesh, Madhya Pradesh, Rajasthan, Haryana, and Gujarat. Mustard contains 17-25% of proteins,

8-10% of fibers, 6-10% of moisture and 10-12% of extractable substances. The oil of mustard possesses a sizable amount of erucic acid (38- 57%). But the presence of toxic glucosinolates in the mustard cake renders it unsuitable as a source of human protein and is at present as manure and as cattle feed.

In India, during 2011-2012, the rapeseed and mustard crop had production of about 6.78 million tons from an area of 5.92 mha with an average productivity of 1145 kg/ ha.

However, in Uttar Pradesh it is grown in 0.64mha with production of 0.72 million tones. The average productivity of Uttar Pradesh is 1125 kg/ ha (Anonymous, 2012). In India, its cultivation is mainly confined in the states *viz.*, Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana, Punjab, Assam, Bihar, Gujarat and West Bengal.

Among the states, Uttar Pradesh alone produces about 20 per cent of total mustard production in India. Indian mustard belongs to cruciferae family, genus Brassica and species juncea. Rapeseed is locally called sarson, toria, yellow toria, whereas, Mustard is called rai or laha. Though, the rapeseed and mustard belong to the same family and genus, they differ with respect to their plant characteristics.

Mustard is cultivated in mostly under temperate climates. It is also grown in certain tropical and subtropical regions as a cold weather crop. Indian mustard is reported to tolerate annual precipitation of 500 to 1200 mm, annual temperature of 6 to 27 OC, and soil pH of 4.3 to 8.3.

Rapeseed - mustard follows C-3 pathway for carbon assimilation. Therefore, it has efficient photosynthetic response at 15 to 20 0C temperature. At this temperature the plant achieve maximum CO_2 exchange range which declines thereafter. Mustard requires well drained sandy loam soil. Rapeseed - mustard has a low water requirement (240 - 400 mm) which fits well in the rainfed cropping system. Nearly 20 % these crops are rain-fed (Shekhawat *et al.*, 2012).

Rapeseed and mustard are usually sown by the end of September to second fortnight of October in north India when grown as a sole crop or on dates of the main crop when sown as mixed or intercrop.

But, with the development of new varieties of crops and adoption of multiple cropping systems under irrigated condition, it has become essential to extend their sowing from October to mid of November or even later.

Singh and Singh (2002) conducted a field experiment at Faizabad (Uttar Pradesh) and recorded higher stover yield with 14th October sowing as compared to 29th October, 13th November and 28th November sowing.

Delayed sowing owing to change in biotic and abiotic environmental conditions may have adverse effect the crop performance. It necessitates developing suitable agro techniques to augment the productivity of the crop.

Among the different agronomic practices, optimum sowing time plays an important role to fully exploit the genetic potentiality of a variety as it provides optimum crop growing environment such as temperature, humidity and light etc. Sowing time is one of the most important non-monetary input which influences to a great extent on both the productivity of seed and oil (Shekhawat *et al.*, 2012).

Awasthi *et al.*, (2007) at Kanpur, Uttar Pradesh, to evaluate the effect of sowing dates (15 and 30 October) on growth and yield of

two varieties of ('Vaibhav' and 'Urwashi') of Indian mustard under rainfed conditions. Sowing on 15 October achieved higher seed compared to sowing on 30 October.

Keeping in view the importance of mustard as a major oil seed crop of this state the present study was investigated to study the "Effect of sowing dates on yield and economics of different Indian mustard (*Brassica juncea* L.) Varieties under late sown conditions" was conducted during *Rabi* season 2019.

Materials and Methods

A field experiment was conducted during kharif season of 2019, at Crop research farm of Department of Agronomy at Sam Higgin bottom University of Agriculture, Technology, and Sciences, Prayagraj which is located at 25^{o} 24' 42" N latitude, 81^{o} 50' 56" E longitude and 98 m altitude above the mean sea level (MSL).

To assess the effect of sowing dates on yield and economics of various Indian mustard (*Brassica juncea* L.) varieties under late sown conditions.

The experiment was laid out in Randomized Block Design comprising of 9 treatments which are replicated thrice. Each treatment net plot size is 3m x 3m. Consisting of 2 factors *i.e.*, Factor-1: Different dates of sowing; at 5th December, 10th December, and 15thDecember and Factor-2: Different varieties of mustard i.e., Varuna, Mahycobold, pioneer; both factors were combined to form 9 treatments T1: Varuna + 5thDecember, T2: Mahyco bold + 5th December, T3: Pioneer + 5thDecember,T4: Varuna + 10th December, T5: Mahycobold + 10th December, T6: Pioneer + 10th December, T7: Varuna + 15th December, T8: Mahycobold+ 15th December, T9: Pioneer + 15th December. During sowing as per the treatment combination, nitrogen fertilizer was applied at three split doses half of the nitrogen fertilizer was applied as basal dose and rest parts are divided equally and applied 45 and 60 days after sowing.

The mustard crop was harvested treatment wise at harvesting maturity stage. After harvesting, grains were separated from each net plot and were dried under sun for three days.

Later winnowed, cleaned and weight of the grain per net plot value, the grain yield per ha was computed and expressed in tonnes per hectare. After complete drying under sun for 10 days straw yield from each net plot was recorded and expressed in tones per hectare. The benefit: cost ratio was worked out after price value of grain with straw and total cost included in crop cultivation.

After thorough field preparation initial soil samples were taken to analyze for available major nutrients. Nitrogen (N), phosphorous (P), potassium (K), sulphur (S), Organic Carbon (OC), pH and soluble salts.

The type of soil in experimental field is sandy clay. The pH of the experimental field was 7.6, EC of 0.30 dS/m, organic carbon was 0.47%.

The N status of the experimental field was low (215 kg/ ha), medium in available P (13 kg/ ha) while available K status was in higher range (233 kg/ ha).

The oxidizable organic carbon was determined by Walkley and Black (1934), pH by pH meter and ECe by electrical conductivity bridge with glass electrode in a 1:2.5 soil water suspension (Jackson 1973).

Available nitrogen was determined by Subbiah and Asija (1956), Available phosphorus was determined by Olsen *et al.*, (1954) and available potash was determined by Flame photometric method, Jackson (1973).

Results and Disscusion

Effect on yield and economics

Grain yield (t/ha)

Significant and highest grain yield (2.60 t/ha) was observed under Varuna sown during 5th December. However, Pioneer sown during 5th December was found to be statistically on par with Varuna sown during 5th December.

The data reveal that date of sowing and varieties significantly influenced the seed yield of mustard. Different dates of sowing under investigation brought significant influence on the seed yield.

Seed yield was significantly affected by the dates of sowing, early sowing has gained maximum yield and also drastically affected by the delay in the sowing might be due to the high temperature at the reproductive stages of the crop Tuteja *et al.*, (1996) and Panwar *et al.*, (2000). Seed yield was significantly influenced due to varieties.

Among the varieties Varuna sown during 5thDecember recorded significantly higher seed yield as compared to mahyco bold and at par with pioneer in the line with Jain *et al.*, (1986) and Porwal *et al.*, (1989) (Table 1).

Straw yield (t/ha)

Similar trend of grain yield was repeated in case of straw yield. Highest straw yield (5.32 t/ha) was observed under Varuna sown during 5th December. However, Pioneer sown during 5th December was found to be statistically on par with Varuna sown during 5th December. Different dates of sowing under investigation brought significant influence on the stover yield. Stover yield has varied from variety to variety. Among the varieties, Varuna recorded significantly higher stover yield as compared to mahyco bold and at par with pioneer.

All the growth and yield attributes which determined the seed and stover yield of mustard crop, were adversely influenced when the sowing was done on too early and late sowing, which might be resulted to poor growth and translocation of photosynthates from source to sink and ultimately lower yield was recorded.

Significant reduction in seed and stover yield of mustard in too early and late sown have also been reported by Panwar *et al.,* (2000) and Sabina *et al.,* (2015).

Effect on economics

Maximum gross return (104 x 10^3), net return (71.62 x 10^3) and Benefit: cost ratio (2.2) was recorded with the T1 Varuna + 5th December sowing.

This was due to higher seed yield and stover yield and net retains obtained with Varuna T-59 + December 5th. Similar results were also reported by Singh *et al.,* (2010).

It is inferred from the present investigation that environmentally and economically, Treatment no.1 Varuna T-59 + 5th December sowing is preferable and suitable for the farmers considering the maximum grain yield (2.60 t/ha), gross return (104 x10^3 INR/ha), net return (71.62 x 10^3 INR/ha) and B:C ratio (2.2) (Table 2).

Table.1 Effect of sowing dates on yield of different Indian mustard (*Brassica juncea* L.) varieties under late sown conditions

Treatment Combinations	Grain yield (t/ha)	Straw yield (t/ha)
T_1-Varuna T-59 + December 5	2.60	5.32
T_2-Mahycobold + December 5	2.45	5.04
T_3-Pioneer 45S46 + December 5	2.26	4.66
T_4-Varuna T-59 + December 10	2.17	4.46
T_5-Mahycobold + December 10	2.15	4.41
T_6-Pioneer 45S46 + December 10	2.12	4.36
T_7-Varuna T-59 + December 15	2.00	4.09
T_8-Mahycobold + December 15	2.08	4.27
T_9-Pioneer 45S46 + December 15	1.90	3.91
SEm (±)	**0.09**	**0.19**
CD (P=0.05)	**0.28**	**0.58**

Table.2 Effect of sowing dates on economics of different Indian mustard (*Brassica juncea* L.) varieties under late sown conditions

Treatment Combinations	Gross return (x 10^3 ₹ /ha)	Net return (x 10^3 ₹ /ha)	Benefit Cost ratio (B:C Ratio)
T_1-Varuna T-59 + December 5	104.00	71.62	2.2
T_2-Mahycobold + December 5	97.87	64.89	2.0
T_3-Pioneer 45S46 + December 5	90.53	56.56	1.7
T_4-Varuna T-59 + December 10	86.93	54.56	1.7
T_5-Mahycobold + December 10	85.87	52.89	1.6
T_6-Pioneer 45S46 + December 10	84.83	50.85	1.5
T_7-Varuna T-59 + December 15	79.87	47.49	1.5
T_8-Mahycobold + December 15	83.3	50.31	1.5
T_9-Pioneer 45S46 + December 15	76.13	42.15	1.2
SEm (±)	**3.20**	**3.20**	**0.07**
CD (P=0.05)	**9.38**	**9.38**	**0.21**

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