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Effect of Seed Rates and Varieties on Yield of Rice Fallow Mustard and their Economics

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A B S T R A C T

A field experiment was conducted during *rabi*, 2017-2018 on clay soils of Agricultural College Farm, Bapatla to find out the effect of seed rates and varieties on yield of rice fallow mustard and to calculate economics**.** The treatments consisted of four seed rates (S_1:6 kg ha^{-1}, S_2:8 kg ha^{-1}, S_3:10 kg ha^{-1} and S_4:12 kgha^{-1}) and three varieties (V_1: NPJ-112, V_2: PM-28, V_3: Pusa bold) and laid out in factorial randomized block design and replicated thrice. Experimental results revealed that significantly highest seed yield (650 kg ha^{-1}) and stalk yield (1450 kg ha^{-1}) was recorded in seed rate 12 kg ha^{-1}. Among varieties PM-28 significantly recorded highest seed yield (665 kg ha^{-1}) and stalk yield (1652 kg ha^{-1}). Significantly highest harvest index (41.5%) was recorded with the variety NPJ-112 and harvest index was non-significant for seed rates. The interaction between seed rates and varieties was found not significant for seed yield, straw yield and harvest index of mustard. The highest gross return (Rs 29, 268 ha^{-1}), net return (Rs 17, 308 ha^{-1}) and return per rupee invested (Rs 1.45) was recorded with the 12 kg seed ha^{-1}. The variety PM-28 recorded highest gross return (Rs 29, 961 ha^{-1}), net return (Rs 18, 241 ha^{-1}) and return per rupee invested (Rs 1.56).

Introduction

Mustard (*Brassica juncea* L.) is the third important oilseed crop in the world after soybean and oil palm. Among the seven edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6% in the total production of oilseeds. India's average production of rapeseed and mustard was 6.2 million tonnes in an area of 5.7 million ha with an average productivity of 10.83 kg ha^{-1} in 2014-15. In AP, the acerage and production of mustard is 0.6 Lakh hectares area and 0.3 Lakh tonnes respectively with productivity of 500 kg ha^{-1} in 2014-15 (http://www.indiastat.com).

The crop can be raised well both under irrigated and rainfed conditions, and also on residual fertility and residual soil moisture conditions, in rice fallows. Effective management of natural resources, integrated approach to plant water, nutrient and pest management and extension of Rapeseed-mustard cultivation to newer areas under different cropping systems will play a key

role in further increasing and stabilizing the productivity and production of rapeseed-mustard. Optimum seed rate play an important role to fully exploit the genetic potential of variety as it provides optimum growth conditions such as temperature, light, humidity, and rainfall etc. A process of yield formation is highly variable and depends on genetic, environmental and agronomic factors as well as interaction between them BebiGogoi (2017). Hence, using improved varieties at optimum seed rate is one aspect in mustard in order to achieve higher yields. In light of these, the present investigation was therefore undertaken to study the effect of seed rates and varieties on yield of rice fallow mustard and to calculate economics**.**

Materials and Methods

Afield experiment was carried out on clay soil of Agricultural College Farm, Bapatla during *rabi*, 2017-18. The soil was saline in reaction and low in organic carbon (0.02 %), low in available nitrogen (226.77 kg ha^{-1}), medium in available phosphorus (31.95 kg ha^{-1}), high in available potassium (556.45 kg ha^{-1}) and available sulphur (23.25 kg ha^{-1}). The experiment was laid out in factorial randomized block design and replicated thrice. The treatment comprised of four seed rates (S_1: 6 kg ha^{-1}, S_2:8 kg ha^{-1}, S_3:10 kg ha^{-1}, S_4:12 kg ha^{-1}) allotted to factor-A and three varieties ($V_{1:}$ NPJ-112, $V_{2:}$ PM-28, $V_{3:}$ Pusa bold) allotted to factor-B. Mustard was sown on 1st December 2017.Mustard was broadcasted before four days of harvesting of rice. The experiment was sown on 01-12-2018 and harvested on 23-02-2018. During the crop growth season climate was nearer to normal. The weekly mean maximum temperatures ranged from 29.94^{0}C to 35.02^{0}Cand the weekly mean minimum temperatures ranged from 16.01^{0}Cto 19.31^{0}C, respectively with average maximum temperatures of 30.89^{0}C and minimum temperatures of 17.82^{0}C, respectively. The weekly mean relative humidity ranged from 60.80 to 74.65 per cent with an average of 71.33 per cent. No rainfall was received during the entire crop growth period. Overall, the climatic conditions were normal and suitable for the successful cultivation of mustard crop with little incidence of pests which were controlled by suitable insecticidal sprays and there was no disease incidence.

Results and Discussion

Seed yield

The seed yield of rice fallow mustard (Table 1) varied significantly due to different seed rates (kg ha^{-1}). The highest seed yield (650 kg ha^{-1}) was recorded with12 kg seed ha^{-1} and was statistically comparable with the seed yield of 601 kg ha^{-1} registered by 10 kg seed ha^{-1} only. The seed yield recorded 601, 577 and 565 kg ha^{-1} in 10 kg ha^{-1}, 8 kg $ha^{-1}$and 6 kg ha^{-1}, seed rates, respectively were statistically comparable with one another. This might be due to higher nutrient uptake, greater vegetative growth, elevated yield attributes, higher dry matter partitioning towards economic part and better light interception. Yield variability among mustard cultivars also attributed to genetic characters and environmental effects Khajuria *et al* (2017). High planting densities promote the development of vegetative organs before anthesis and effective nutrition uptake dynamics to the reproductive organs after anthesis, which strongly increased seed yield Ma *et al* (2014).

Seed yield of rice fallow mustard was also significantly influenced by the varieties under test. The highest seed yield of 665 kg ha^{-1} was registered by PM-28 variety which was significantly superior to Pusa bold (511 kg ha^{-1}) only and statistically comparable to NPJ-112 with 618 kg seed yield per hectare.

Production of higher yield by different varieties might be due to the contribution of cummulative favorable effects of the crop characteristics *viz.,* number of branches per plant, siliquae per plant and seeds per siliquae Meena *et al* (2013).

Stalk yield

Data pertaining to stalk yield for rice fallow mustard are presented in (Table 1) and the data reveals that significantly the highest stalk yield was registered in the treatment receiving 12 kg seed ha^{-1} (1450 kg ha^{-1}) and was significantly superior to the lowest seed rate *i.e.* 6 kg ha^{-1} recorded 1300 kg ha^{-1} stalk yield alone. 12 kg seed rate ha^{-1} was statistically comparable with 10 kg seed ha^{-1} (1395 kg ha^{-1}) and 8 kg seed rate ha^{-1} (1346 kg ha^{-1}). The highest stalk yield was observed at higher planting density whereas, the lowest was observed at lower planting density. The decrease in stalk yield from higher to lower planting density is mainly attributed to the higher plant population unit $area^{-1}$Neha *et al*(2014).Higher plant population at higher seed rates, taller plants, more dry matter per unit area at higher plant populations might be the reason for the higher stalk yield at higher populations. Similar findings were also reported by Thakuria and Thakuria (2014).

There was a significant influence of varieties on the stalk yield of rice fallow mustard. The highest stalk yield was registered by PM-28 (1652 kg ha^{-1}) and it was followed by NPJ-112 (1287 kg ha^{-1}). The lowest stalk yield was registered by Pusa bold with 1179 kg ha^{-1}. This might be due to the plant height, dry matter accumulation and number of branches per plant was higher in PM-28 variety and was followed by NPJ-112 variety. Such varietal variation due to varieties was also ascribed by other scientists such as Khajuria *et al.,* (2017).

Harvest index

Data pertaining to harvest index of rice fallow mustard are presented in Table 1 and the data reveals that varieties alone significantly influenced the harvest index and seed rate interaction with varieties was also not significant.

Harvest index was not significantly influenced due to different seed rates. The reason for the non-significant difference might be the non-dependence of this character due to fact this is more genetically influenced.

Varieties differed significantly among themselves in this regard. Highest harvest index (41.5%) was recorded with the variety NPJ-112, which was on par with PM-28 (33.1%) and Pusa bold (32.4%). This character is the important yield attributes in the oil producing plants. Slight variations in harvest index, makes the greater dependence of this character, to the genetic structure of the plant. The balance between vegetative organs and reproductive reason for the slight variation in harvest index. Kumar *et al* (2017) also reported similar results.

Economics

The data on economics of rice fallow mustard as influenced by various seed rates and varieties are presented in Table 2. Significantly, the highest gross return (Rs29, 268 ha^{-1}) was recorded in the treatment receiving 12 kg seed ha^{-1} and was statistically comparable with the gross return of Rs 27, 036 registered by the treatment received 10 kg ha^{-1} only. The gross return recorded Rs 27, 036 ha^{-1}, Rs 25, 990 ha^{-1} and Rs 25, 445 ha^{-1}in 10 kg ha^{-1}, 8 kg ha^{-1} and 6 kg ha^{-1}, seed rate treatments, respectively were statistically comparable with one another. Seed yield at high seed rates was also higher. Hence these higher seed yields might have contributed for

higher gross return. The current results are in conformity with the findings of Sharma (2013).

Significantly, the highest net return (Rs 17, 308 ha^{-1}) was recorded in the treatment receiving 12 kg seed ha^{-1} and was statistically comparable with the net return of Rs 15, 236 ha^{-1}registered by the treatment received 10 kg ha^{-1} only. The net return recorded Rs 15, 236 ha^{-1}, Rs 14, 350 $ha^{-1}$and Rs 13, 966 ha^{-1} in 10 kg ha^{-1}, 8 kg ha^{-1} and 6 kg ha^{-1}, seed rate treatments, respectively were statistically comparable with one another. Lower seed yields at lower seed rates fetched lower gross return and net return. Similar findings were reported by Sharma (2013). Significantly, the highest return per rupee invested (Rs 1.45) was recorded in the treatment receiving 12 kg seed ha^{-1} and was statistically comparable with Rs 1.29 registered by the treatment received 10 kg ha^{-1} only. Return per rupee invested recorded Rs 1.29, Rs 1.23 and Rs 1.29 in 10 kg ha^{-1}, 8 kg ha^{-1} and 6 kg ha^{-1}, seed rate treatments, respectively were statistically comparable with one another. This might be because of lesser grain yield and stover yield at the lowest seed rates of rice fallow-mustard. The results are in agreement with the findings of Meena *et al.*, (2017).

Table.1 Seed yield (kg ha^{-1}), Stalk yield (kg ha^{-1}) and Harvest Index (%) of rice fallow mustard as influenced by seed rates and varieties

Treatment	Seed yield	Stalk yield	Harvest Index
Seed rates (kg ha^{-1})			
S_1 - 6	565	1300	35.7
S_2 - 8	577	1346	35.8
S_3 - 10	601	1395	35.5
S_4- 12	650	1450	35.8
S.Em±	20.18	36.31	1.98
CD (p = 0.05)	59	106	NS
Varieties			
NPJ-112	618	1287	41.5
PM-28	665	1652	33.1
Pusa bold	511	1179	32.4
S.Em±	17.47	31.44	1.72
CD (p = 0.05)	51	92	5.0
Interaction (S X V)			
S.Em±	34.95	62.89	3.44
CD (p = 0.05)	NS	NS	NS
CV (%)	10.1	7.4	16.6

Table.2 Economics of rice fallow mustard as influenced by seed rates and varieties

Treatment	Cost of cultivation (Rs ha^{-1})	Gross Return (Rs ha^{-1})	Net Return (Rs ha^{-1})	Return per Rupee Investment
Seed rates (kg ha^{-1})				
S_1 - 6	11480	25445	13966	1.22
S_2 - 8	11640	25990	14350	1.23
S_3 - 10	11800	27036	15236	1.29
S_4 - 12	11960	29268	17308	1.45
S.Em±	-	908.17	776.77	0.06
CD (p = 0.05)	-	2663	2277	0.17
Varieties				
NPJ-112	11720	27840	16120	1.37
PM-28	11720	29961	18241	1.56
Pusa bold	11720	23005	11285	0.96
S.Em±	-	786.50	672.70	0.05
CD (p = 0.05)	-	2306	1972	0.15
Interaction (S X V)				
S.Em±	-	1573.00	1345.40	0.10
CD (p = 0.05)	-	NS	NS	NS
CV (%)	-	10.1	15.3	13.8

Significantly the highest gross return was recorded in the variety PM-28 (Rs29, 961 ha^{-1}), which was on par with NPJ-112 (Rs 27, 840 ha^{-1}). Whereas the lowest gross returns (Rs 23, 005 ha^{-1}) was reported in the variety Pusa bold. Significantly the highest net return was recorded in the variety PM-28 (Rs 18, 241 ha^{-1}), which was on par with NPJ-112 (Rs16, 120 ha^{-1}). Whereas the lowest net returns (Rs11, 285 ha^{-1}) was reported in the variety Pusa bold.

Significantly the highest return per rupee invested was recorded in the variety PM-28 (Rs 1.56), which was on par with NPJ-112 (Rs 1.37). Whereas the lowest return per rupee invested (Rs 0.96) was reported in the variety Pusa bold. This might be ascribed to higher seed and stalk yield in the variety PM-28. Results of the current experiment are in conformity with the findings of Meena *et al* (2017).

It can be concluded that 12 kg ha^{-1} seed rate registered higher yield, gross return, net return and return per rupee invested and hence 12 kg seed rate ha^{-1} was found to be optimum in rice-fallows compared to 10 kg ha^{-1}, 8 kg ha^{-1} and 6 kg ha^{-1} seed rates. Among varieties PM-28 variety performed better than NPJ-112 and Pusa bold with higher yield, gross return, net return and return per rupee invested.

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