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INFLUENCE OF INTERCROPPING OF MUSTARD WITH CHICKPEA AND LINSEED

Samiksha Nakat[1], V. S. Khawale[2], R. B. Kothikar[3], G. V. Lunge[4] and C. D. Dhamankar[5]

ABSTRACT

Chickpea with mustard or linseed with mustard is a prominent intercropping system of Indian Sub-Continent under resource constraint conditions. The population ratio and nutrient management strategies have significant bearing on the performance and economic feasibility of component crops in mixed stands. Therefore, an investigation was carried out to study the influence of intercropping pattern of mustard with chickpea and linseed at Agronomy farm, College of Agriculture, Nagpur during *rabi* season of the year 2021-22 to evaluate the yield, yield contributing parameters and economics of mustard based intercropping system. The experiment was laid out in Randomized Block Design with four replications and seven treatments viz., T1 - Sole chickpea, T2 - Sole mustard, T3 - Sole linseed, T4 - Chickpea + mustard (6:1), T5 - Chickpea + mustard (5:2), T6 - Linseed + mustard (6:1) and T7 - Linseed+ mustard (5:2). The results revealed that yield contributing parameters like number of siliqua pods^{-1} and capsules plant^{-1}, number of seeds siliqua^{-1}, pod^{-1} and capsule^{-1}, seed yield plant^{-1} and test weight recorded higher values of chickpea and linseed in sole stand of chickpea and linseed + mustard (6:1) respectively however, incase of mustard higher values were recorded in chickpea + mustard (5:2). In mustard significantly highest values of MEY (23.81 q ha^{-1}), GMR (123812 Rs. ha^{-1}), NMR (82221 Rs. ha^{-1}) and B:C ratio (2.98) were recorded with the treatments T5 – Chickpea + mustard (5:2) followed by T7 - Linseed+ mustard (5:2) and also highest LER of 1.71 and 1.47 were recorded with the treatments T5 – Chickpea + mustard (5:2) and T7 - Linseed+ mustard (5:2), respectively. Highest values of mustard as a intercrop noticed with the treatment T5 – Chickpea + mustard (5:2).

(Key words: Intercropping, mustard, chickpea, linseed, mustard, MEY, LER, economics)

INTRODUCTION

Indian mustard (*Brassica juncea* L.) is locally called rai, raya, laha and whereas, rapeseed is called sarson, toria and yellow toria. Mustard is a major rabi oilseed crop of India and widely grown in subtropical regions of the world. Its green tender plants are used for preparing vegetable commonly called as "Sarson ka Saag". Mustard oil is utilized for human consumption throughout Northern India in cooking and frying purpose. The whole seed is used as condiment in the preparation of pickles and for flavouring curries and vegetable ghee, hair oil, medicines, soaps, lubricating oil and in tanning industries and Rapeseed is grown for the production of animal feed, vegetable oil for human consumption and biodiesel. The oil content in mustard seeds varies form 37-49 per cent (Bhowmik *et al.,* 2014). Growth of more than one crop species or cultivars simultaneously in the same land is a practical application of ecological principles such as diversity, crop interaction. There are very close relationships between yield advantage and nutrient acquisition in intercropping systems. It is mainly related to complementary use of environmental resources by the component crops which result in increased and more stable yields. Intercropping has potential to increase net returns, reduce the risk of crop failure and reduce environmental impacts. Hence, promising mustard based intercropping system was tested for their response with chickpea and linseed to evaluate their yield potentiality and system profitability. Intercropping as an economical method for higher production with lower levels of external inputs and it is important, especially for small-scale farmers and also in areas where growing season is short. Intercropping of mustard with chickpea and linseed is traditional practice to realise yield stability as well as to fulfil the needs of oil and pulses. The advantages of intercropping system are more apparent when co-crops have different requirements of available resources, in quantity, quality and time of demand (Zohry and Ouda, 2019). If recommended row ratio of mustard with chickpea and linseed for specific area is adopted then farmers could utilize variable resources more efficiently and effectively on sustainable basis. Intercropping mustard with chickpea and linseed add even much more nitrogen than what is being added in soil through chemical fertilizers. It is therefore the present investigation

1, 4 and 5. P.G. Students, Dept. of Agronomy, College of Agriculture (Dr. PDKV), Nagpur, Maharashtra
2. Professor, Dept. of Agronomy, College of Agriculture (Dr. PDKV), Nagpur, Maharashtra
3. Jr. Res. Assistant, College of Agriculture (Dr. PDKV), Nagpur, Maharashtra

was carried out to study the profitable row proportion to get maximum yield and higher monetary returns to farmers. Therefore area under mustard cultivation in Vidarbha is continuously going down. Considering the low production in Vidarbha region as compared to India, there is need of producing high yielding varieties with early maturity and high oil contain which will perform stable in terminal heat shock (Ingole *et al.,* 2021).

MATERIALS AND METHODS

A field experiment entitled "Yield, Mustard Equivalent Yield, Land Equivalent Ratio and economics as influenced by intercropping pattern of mustard with chickpea and linseed" was conducted at Agronomy Farm, College of Agriculture, Nagpur, during *rabi* season of 2021- 22. The experiment was laid out in Randomized block design with four replications and seven treatments *viz*., T1 - sole chickpea, T2 - sole mustard, T3 - sole linseed, T4 - chickpea + mustard (6:1), T5 - chickpea + mustard (5:2), T6 - linseed+ mustard (6:1) and T7 - linseed+ mustard (5:2). The observations were recorded on yield contributing parameters like number of siliqua, pods and capsules plant^{-1}, number of seed siliqua^{-1}, pod^{-1}, capsule^{-1}, seed yield plant^{-1}, test weight seed yield and straw yield at the harvest of the crops. Further data was collected and analysed statistically as per method suggested by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Yield contributing parameters of mustard as influenced by intercropping patterns

The results revealed that yield contributing parameters like number of siliqua plant^{-1}, number of Seed siliqua^{-1}, seed yield plant^{-1} and test weight of mustard recorded higher values in chickpea + mustard (5:2). Alam *et al*. (2015) observed that yield attributing characters of mustard that is number of siliquae plant^{-1}, number of seeds siliquae^{-1} and 1000 seed weight were higher in chickpea + mustard 5:2 row ratio of intercropping than sole mustard and chickpea + mustard (6:1). This might be due to lesser inter crop competition, higher photosynthetic active radiation and latent heat available to the crops leading to higher production of photosynthates which together favorably influenced the yield attributing parameters.

Grain yield and straw yield of mustard as influenced by intercropping patterns

Data regarding seed yield (q ha^{-1}) of mustard as influenced by various treatments are presented in Table 2. Seed yield of mustard was influenced by different intercropping system and row ratio. The higher seed yield of mustard (13.93 q ha^{-1}) was recorded in sole mustard (T2) and lowest seed yield of mustard (3.16 q ha^{-1}) was observed in chickpea with mustard intercropping in row ratio of 6:1. Superiority of sole cropping over intercropping patterns might be attributed to higher plant population under sole cropping of mustard, uniform and optimal utilization of plant resources under uniform crop stand. These results are in agreement with finding of Kumar *et al.* (2014), who reported that mustard yield was significantly higher when grown as a sole crop than that grown as intercrop with other crops. While intercropping of pulses, linseed and potato with mustard, intercropping of pulses and linseed with mustard produced significantly higher yield of mustard than that of intercropping with potato. This might be due to pulses add even much more nitrogen than what is being added in soil through chemical fertilizers. Mustard when intercropped with chickpea and linseed, maximum seed yield of 9.67 q ha^{-1} was recorded in linseed with mustard in row ratio of 5:2 followed by chickpea with mustard in row ratio of 5:2 (7.24 q ha^{-1}). This might be due to better availability of nutrients and moisture and optimal utilization of other plant growth resources due to different growth under different root zone. These findings are similar with Thakuria and Saud (2016). They revealed that almost intercropping in all row proportion were superior to their sole cropping. However, intercropping of Toria + Linseed 2:2 and 1:1 row proportion and Toria +Yellow Sarson 2:1 and 2:2 row proportion recorded higher mustard seed yield over other intercropping system which might be due to relative yield increase of Toria in association with linseed and Yellow Sarson.

Straw yield of mustard was influenced by different intercropping systems and row ratio. The maximum straw yield (42.48 q ha^{-1}) of mustard was recorded in sole mustard (T2). Mustard when sown as intercropped with linseed in row ratio of 5:2 recorded higher value of straw yield i.e. 15.55 q ha^{-1}. Increased straw yield might be due to luxurious crop growth, higher plant population ha^{-1} resulting increase in dry matter accumulation. These findings are in close conformity with the results of Singh and Sahu, (2012). They reported that intercropping treatments and nutrient management had significant effect on yield of mustard among different intercropping system i.e chickpea + mustard (3:1). Additive series recorded highest yield which is at par with chickpea + mustard (4:1) and significantly superior over chickpea+ mustard (3:1) in replacement series. The higher grain and straw yield in additive series might be due to higher dry matter accumulation and also more translocation of photosynthates towards sink.

Mustard equivalent yield

Data presented in Table 2 revealed that, different row ratio of mustard intercropping system significantly influenced the mustard equivalent yield ha^{-1}. Mustard intercropped with chickpea in row ratio of 5:2 recorded significantly highest mustard equivalent yield of 23.81 q ha^{-1} as compared to all the intercropping system and row ratio. Lowest mustard equivalent yield of 12.26 q ha^{-1} was observed in sole linseed crop. The highest mustard equivalent yield in chickpea with mustard intercropping in row ratio of 5:2 might be because of chickpea being legume crop having complementary effect of both crops on each other which benefited both the crop yield. Rohit and Singh (2020) observed that chickpea + mustard (5:1) intercropping

Table 1. Yield contributing characters of mustard, chickpea and linseed as influenced by intercropping systems

Treatments		Number of siliqua/pods /capsules plant^{-1}		Number of seed siliqua/ pods/capsules		Seedyield plant^{-1} (g)		Test weight (g)	
		Mustard	Intercrops	Mustard	Intercrops	Mustard	Intercrops	Mustard	Intercrops
T1	SoleChickpea	-	64.30	-	1.75	-	12.08	-	21.04
T2	SoleMustard	220.25	-	13.65	-	9.43	-	5.33	-
T3	SoleLinseed	-	46.68	-	5.57	-	4.68	-	7.00
T4	Chickpea +mustard(6:1)	265.25	61.48	13.43	1.50	9.98	11.30	5.45	20.32
T5	Chickpea +mustard(5:2)	285.25	58.43	13.90	1.25	11.25	11.10	5.73	20.15
T6	Linseed+mustard(6:1)	261.25	52.43	12.73	7.50	9.78	5.24	5.35	7.68
T7	Linseed+mustard(5:2)	279.75	48.20	13.33	7.25	11.03	3.66	5.53	7.26
	G.M.	262.35	-	13.40	-	10.29	-	5.47	-

Table 2. Yield, MEY, LER and economics as influenced by intercropping pattern of mustard with chickpea and linseed

Treatments		Seed yield (qha^{-1})		Straw yield (q ha^{-1})		Harvest index (%)		MEY (q ha^{-1})	LER	GMR (Rs ha^{-1})	NMR (Rs ha^{-1})	B:C Ratio
		Mustard	Intercrops	Mustard	Intercrops	Mustard	Intercrops					
T1	Solechickpea	-	17.76	-	28.03		38.78	18.78	1.40	97656	54895	2.28
T2	Solemustard	13.93	-	42.48	-	24.69	-	13.93	1.00	72436	33730	1.87
T3	Solelinseed	-	10.29	-	15.26		40.27	12.26	0.88	63752	22791	1.56
T4	Chickpea+mustard (6:1)	3.16	14.14	9.55	19.08	24.86	42.56	18.11	1.30	94172	51909	2.23
T5	Chickpea+mustard (5:2)	7.24	15.67	14.26	21.01	33.67	42.72	23.81	1.71	123812	82221	2.98
T6	Linseed+mustard(6:1)	6.64	8.24	10.19	12.71	39.45	39.33	16.46	1.18	85592	45814	2.15
T7	Linseed+mustard(5:2)	9.67	9.02	15.55	13.67	38.34	39.75	20.42	1.47	106184	66573	2.69
	SE(m)+	-	-	-	-	-	-	0.54	-	2821	2821	-
	CD at5%	-	-	-	-	-	-	1.61	-	8382	8382	-
	G.M.	-	-	-	-	-	-	17.68	-	91943	51133	2.25

system has potential for increased crop production and for achieving greater yield stability in dry land areas. The higher mustard equivalent yield of mustard (1971 kg ha^{-1}) was recorded in mustard+ chickpea intercropping which was 54.5% more as compared to sole mustard crop. Intercropping resulted in higher income of Rs 24646 ha^{-1} over sole mustard.

Results reveled that intercropping system, namely mustard + chickpea sowing in additive series found superior as compared to other intercropping system in mustard equivalent yield, net return and benefit: cost ratio. However, dust mulching at 25 DAS gave higher mustard equivalent seed yield and land equivalent ratio over without dust mulch treatment. The higher water use efficiency and net return were recorded when dust mulching practice was adopted.

Harvest index of mustard

Higher harvest index of mustard was recorded in 6:1 row ratio of linseed with mustard (39.45%) followed by 5:2 row ratio of linseed with mustard (38.34%), chickpea with mustard (33.67%) in row ratio of 5:2. However, lowest harvest index was found in sole mustard (24.69%). These findings are in close conformity with the results of Ramrao *et al., (*2020). They reported that harvest index of mustard was maximum in linseed + mustard (28.72%) and found at par with chickpea + mustard (3:3) (26.93%). The higher harvest index of mustard was recorded when intercropped with linseed. It might be due to less plant population of mustard and appropriate row to row spacing intercropping.

Land Equivalent Ratio of mustard

Land Equivalent Ratio varied with different intercropping and row ratio of mustard. Highest value of LER was recorded in chickpea with mustard in row ratio of 5:2 intercropping which recorded 1.71 followed by linseed with mustard in row ratio of 5:2. However, the minimum LER of 0.88 was recorded in sole linseed. Higher LER of intercropping system obtained might be due to higher yield of linseed and mustard and also due to optimal utilization or all production resources in intercropping system over its sole cropping system. This indicated that biological efficiency was greater under intercropping system. Indian mustard+ linseed intercropping recorded highest land equivalent ratio (1.63) which is significantly higher than other intercropping treatments (Narayan et al., 1999).

Economics as influenced by intercropping patterns

As regards economics, highest gross monetary returns (Rs. 123812 ha^{-1}), net monetary returns (Rs. 2221 ha^{-1}) and B:C ratio of 2.98 were recorded with chickpea with mustard (5:2) (T5) as compared to other intercropping system and different row ratios. The similar findings were also reported by Singh and Sahu (2012). They stated that highest net monetary advantage was obtained in 6:2 row ratio of chickpea + mustard intercropping system followed by 5:1and 6:1 row ratios of chickpea+ mustard. However, minimum net return and lowest B:C ratio was observed in sole mustard. Highest benefit: cost ratio was reported in chickpea+ mustard (6:2) row ratio this might be due to maximum net return value which is best and viable alternative intercropping system for farmers. B:C ratio of (2.98) were recorded with chickpea with mustard (5:2) (T_5) as compared to other intercropping system and different row ratios. The similar findings were recorded by Singh and Sahu, (2012).

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