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Yield Analysis of Chickpea (*Cicer arietinum*) with Mustard (*Brassaca juncea*) Intercropping System as Influenced by Weed Management Practices

R.L. Rajput, B.B. Kushwaha[1]

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ABSTRACT

Background: Intercropping is the more profitable cropping system in Agriculture for marginal hold farmers. In this system risk cover in abiotic stress and farmers have gain one crop mostly who are using herbicide to control weeds. Crops raise fast and with controlled weeds. Scientific approach of intercropping increases the productivity per unit area and per unit time under a situation where two crops are grown in a certain row proportion. The selection of compatible crops is one of the important considerations, in deciding economically viable and feasible intercropping system. Chickpea with mustard is a prominent intercropping system in Indian subcontinent. The majority of the farmers adopt this system under recourse constraint conditions. Since Chickpea is a poor competitor for weeds because of its slow growth and limited leaf area development at early stages of crops growth and establishment.

Methods: An experiment was conducted at College of Agriculture Farm Gwalior during *Rabi* season of 2011-12 and 2012-13. The experiment was laid out in Split-Plot Design with three replications. Eighteen treatment combinations comprising three intercropping systems, *viz*, chickpea (sole), mustard (sole) and chickpea with mustard were taken as main plot treatments and six weed management practices *viz*, weedy-check, weed free, fluchloralin@ 1.0kg/ha pre-plant incorporation (PPI), pendimethalin @ 1 kg/ha as pre-emergene, (PE), Isoproturon 0.75 kg/ha as post emergence (POE) and quizalofop -ethyl @50 ml/ha (PoE) as sub plot treatments. The recommended dose of fertilizer in chickpea 18 kg/ha of nitrogen and 46 kg/ha of P_2O_5 were applied with equal distribution to both the crops through 100 kg /ha diammonium phosphate as basal application at the time of sowing in rows below the seed. A seed rate of 70 kg and 5 kg/ha for chickpea and mustard was used in their sole crops respectively.

Result: Chickpea with mustard intercropping system proved to be the most promising system which obtained more net returns and benefit: cost ratio. So for realizing higher net returns and benefit: cost ratio, chickpea with mustard may be recommended to farmers who are interested in taking both the crops instead of their pure stands as it proved to be economically better and feasible in generating more monetary benefits by spending fewer amounts for their better lively hood security as well as land use efficiency.

Key words: Chickpea, Intercropping, Mustard, Weed management.

INTRODUCTION

Intercropping can be a suitable and viable agronomic practice for stepping up the production and yield stability from a unit of land during a cropping period. It increases the intensity, productivity and profitability under optimum utilization of soil, water, nutrients and sunlight in time and space. Scientific approach of intercropping increases the productivity per unit area per unit time under a situation where two crops are grown in a certain row proportions. It has gained interest because of potential advantages it offers in yield through improved utilization of resources by the crops and particularly when a legumes is grown in association with another crop in an intercropping system.

Initial slow growth of the crops and adequate soil moisture provide conducive conditions for profuse growth of weeds relatively in wide-spaced crops. This necessitates that a systematic study on weed dynamics in such crops is essential for strategic weed management planning. The traditional methods of weed controls very often back breaking, costly, time consuming and needs so much of human labour and resources that this work often gets neglected or is given up during the peak periods of labour shortage. Use of the herbicides is, thus, the only resort as it offers a good scope for timely and adequate control of weeds. Efficiency of weed control in crops can be further enhanced if herbicidal treatments are coupled with intercropping rather than their sole cropping, as intercropping also plays a very significant role in suppression of weeds through their smothering effect. The selection of compatible crops is one of the important considerations, in deciding economically viable and feasible intercropping

Rajmata Vijavaraje Scindia Krishi Vishwa Vidyalay, Gwalior-474 002, Madhya Pradesh, India.
[1]College of Agriculture, Indore-452 001, Madhya Pradesh, India.

Corresponding Author: B.B. Kushwaha, College of Agriculture, Indore-452 001, Madhya Pradesh, India.
Email: kushwaha606@gmail.com

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system. Chickpea with mustard is a prominent intercropping system in Indian subcontinent. The majority of the farmers adopt this system under recourse constraint conditions. Since Chickpea is a poor competitor for weeds because of its slow growth and limited leaf area development at early stages of crops growth and establishment. Among the various pulse crops, chickpea is the most important winter pulse crop of Indi which is grown both under assured irrigation as well as on residual soil moisture of *Kharif* rains during winter (*Rabi*) season. Therefore, intercropping of mustard with chickpea coupled with effective weed control measures may help the farming community to realize the potential yield of chickpea to its maximum with an additional yield of mustard which is raised as an intercrop since, there is scarcity of information on the efficacy of herbicides for controlling weeds in chickpea with mustard intercropping, the present experiment was conducted to study the dynamics of intercrop situations through computation of various indices and to work out the relative economics of the treatments.

MATERIALS AND METHODS

An experiment was conducted at College of Agriculture Farm Gwalior during *Rabi* season of 2011-12 and 2012-13. The soil was sandy loam with slightly alkaline (pH 7.8), medium in organic carbon (0.62%) and available nitrogen (256.2 kg/ha) phosphorus (13.63 kg/ha) and it- otesignwith three potassium (165.5 kg/ha). The experiment was laid out in Split-Plot Design with three replications. Eighteen treatment combinations comprising three intercropping systems, *viz*, chickpea (sole), mustard (sole) and chickpea with mustard were taken as main plot treatments and six weed management practices *viz*, weedy-check, weed free, fluchloralin@ 1.0kg/ha pre-plant incorporation (PPI), pendimethalin @ 1 kg/ha as pre-emergene, (PE), Isoproturon 0.75 kg/ha as post emergence (POE) and quizalofop–ethyl @50 ml/ha (PoE) as sub plot treatments. The recommended dose of fertilizer in chickpea 18 kg/ha of nitrogen and 46 kg/ha of P_2O_5 were applied with equal distribution to both the crops through 100 kg /ha diammonium phosphate as basal application at the time of sowing in rows below the seed. A seed rate of 70 kg and 5 kg/ha for chickpea and mustard was used in their sole crops respectively, the row ratio of intercropping system was taken (2:1) chickpea +Mustard in apart of 30 cm row to row and plant to plant 10 cm. whereas the seed rate of both the crops for intercropping was used as 50% less than seed rate used in the sole crops. Both chickpea and mustard crops were sown on 15 October 2011-12 and 22 October, 2012-13, respectively. The land equivalent ratio (LER), relative yield total (RYT), land use efficiency (LUE) and production efficiency (PE) were calculated as per standard methods.

$$LER = \sum (Ypi/Ymi)$$

Where,

Yp is the yield of each crop or variety in the intercrop and Ym is the yield of each crop.

Relative Yields Total (RYT):

$$RYT = \frac{Yab+Yba}{Yaa+Ybb}$$

Where

Yaa = yields of component a as sole crop, Ybb = yields of component b is a sole crop, Yab = yields of component a as intercrop in b, Yba = Yield of component b as intercrop in a.

$$LUE\ (\%) = \frac{TND\ (i)}{365} \times 100$$

Where,

TND (i) - Total number of days field remained occupied under different crops (i=1...n).

Production efficiency (Kg/ day)

Production efficiency (PE) is worked out as given below to find out the economics of individual intercropping system.

$$PE = \frac{Equivalent\ Yield\ (kg)}{Duration\ (Days)}$$

RESULTS AND DISCUSSION

Yield kg/ha

Chickpea and mustard was the highest in their sole stand with respect to yield. Among the intercropping systems chickpea + mustard gave the highest chickpea equivalent seed yield as compared to sole crop of chickpea. Among weed management practices, the highest seed yields of chickpea and mustard were obtained under weed free treatment. Application of pendimethali@ 1.0 kg/ha recorded significantly higher seed yield of chickpea and mustard as compared to weedy check. Fluchloralin @ 1 kg/ha and quizalofop-ethyl @ 50ml/ha were also effective in controlling weeds and registered higher seed yield of chickpea and mustard than rest of theherbicides used. Kour *et al*. (2015) reported that yield of chickpea and mustard was increased by 40.7 and 55% with the application of fluchloralin and 37.1 and 57.2 by pendimethalin in chickpea and mustard intercropping System. Arya (2004) in chickpea + mustard also reported similar results.

Land equivalent ratio (LER)

(Land equivalent ratio is relative land area under sole crops required to produce the same yield as were obtained under their intercropping and the land equivalent ratio of more than unity expresses that the biological efficiency of such system is higher). The LER of chickpea + mustard intercropping was found biologically more efficient and which is quite obvious from their LER values of 1.75 (Table 1).

Relative yield total (RYT)

Relative yield total of 1.40 was obtained under chickpea + mustard intercropping system which indicated a yield advantage of 40% over sole chickpea. Urdie *et al*. (2012) also reported similar findings for RYT intercropping of maize + soybean.

Table 1: Effect of chickpea + mustard intercropping system on production land equivalent ratio, relative yield total land use efficiency, production efficiency and economics as influenced weed management practices (Pooled over two year).

Treatments	Yield (kg/ha)		LER	RYT	LUE	PE	Net returns (Rs/ha)	Equivalent yield (kg/ha)	Benefit cost Ratio
	Chickpea	Mustard							
Intercropping System									
Sole chickpea	985	-	-	-	44.82	6.42	12415	985	0.86
Sole mustard	-	1235			36.72	5.63	13820	1409	1.20
Chickpea + mustard	762	996	1.75	1.4	45.22	8.88	25618	1898	1.81
SEm±	023	027	-	-	-	-	-	-	-
CD at 5%	071	082	-	-	-	-	-	-	-
Weed management									
Weedy Check	488	565	-	-	44.21	4.31	9705	1132	0.52
Weed free	990	1200	-	-	45.85	8.25	16511	2359	1.10
Fluchloralin @ Ikg/ha as (PPI)	875	1102	-	-	45.25	6.75	20316	2132	1.75
Pendimethanlin @1kg/ha as (PE)	965	1145	-	-	45.11	7.44	21618	2271	1.80
Isoproturon @0.75 kg/h as(POE)	730	1010	-	-	45.63	6.32	16712	1881	1.66
Quizalofop-ethyl@50ml/ha as(POE)	741	1062	-	-	44.43	6.45	17115	1954	1.71
SEm±	030	035	-	-	-	-	-	-	-
CD at 5%	090	103	-	-	-	-	-	-	-

Land use efficiency

The highest value of land use efficiency was achieved under intercropping system than their respective sole crops stands. This could be attributed to the increased light interception, reduced water evaporation that improved conservation of the soil moisture in intercropping treatment compared to sole cropping. These results confirms the findings of Kour *et al*. (2015) and Ghanbari *et al*. (2010), they also reported that intercropping system have been found to enhance land utilization efficiency. Among the weed management treatments, highest land use efficiency was recorded in weed free treatment over rest of the treatments. (Pendimethalin recorded higher land use efficiency followed by fluchloralin, where as it was lower in isoproturon @ 0.75 kg/ha). This could have happened due to the fact that effective control of weeds by weed-management treatments might have provide a competition free environment that led to increased land use efficiency as compared to weedy check plots.

Production efficiency

Production efficiency calculated on chickpea equivalent yield basis indicated that highest value of production efficiency (8.88) was recorded in intercropping system as compared to sole chickpea and mustard during both the years. This can be ascribed to better utilization of resources by the component crops in an intercropping combination accompanied with discouraged weed population and weed dry matter due to smothering effect of the crops which might have provided an advantage in the production of component crops in totality as compared to sole chickpea and mustard. These results are in agreement with the findings of Tripathi *et al*. (2010). Among the weed management practices, the highest production efficiency (8.25) was recorded with d free treatment, while the lowest value was recorded in weedy check treatment (4.31) during both the years. Pendimethalin recorded higher value of production efficiency (7.44) followed by ftuchloralin and quizalofop-ethyl, while relatively, lower value of production efficiency was recorded with isoproturon followed by quizalofop-ethyl during both the seasons respectively.

Economics

As regards variations realized in gross return under different intercropping and weed management treatments, the possible reasons were differences in seed yield of chickpea and mustard crops attained in treatments 10 with their respective sale rates. The highest net return (Rs 25618) obtained under intercropping system over sole chickpea and mustard treatment might be owing to the highest chickpea equivalent yields acquired in this treatment. Among the weed management practices, the highest and lowest net returns under different herbicidal treatments were because of dissimilarities in the cost as well as quantity of herbicides used herbicide-applied treatments and in weed free treatment. The highest net returns and B:C ratio (Rs 21618 and 1.81) were recorded with pre-emergence of pendimethalin @1 kg /ha followed by pre plant-incorporation of fluchloralin @ 1kg /ha (Rs 20316 and 1.75) Lowest net return and B:C Ratio were recorded by weedy check followed by weed free condition. It was mainly owing to extra labours engaged in manual removal of weeds, Tripathi *et al*. (2005) reported similar results in respectof net return and benefit: cost ratio in chickpea + mustard intercropping system. Arya (2004) reported similar findings with the application of pendimethalin for net returns and benefit: cost ratio in weed management treatments, Kour *et al*. (2015) confirms the similar findings with regard for economics of weed management treatment. Thus Chickpea + mustard

intercropping system proved to be the most promising system which obtained more net returns and benefit: cost ratio. So for realizing higher net returns and benefit : cost ratio, chickpea + mustard may be recommended to farmers who are intrested in taking both the crops instead of their pure stands as it proved to be economically better and feasible in generating more monetary benefits by spending less amount for their better lively hood security as well as land use efficiency.

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