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Effect of different crop establishment methods and weed management practices on finger millet (*Eleusine coracana* L. Gaertn) under rainfed situation

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Abstract

A field experiment was conducted at S.G. College of Agriculture and Research Station, Jagdalpur during *Kharif* season 2011 and 2012 in a spilt plot design with three replications to find out the effect of weed management practices and different crop establishment methods on growth and yield of finger millet (*Eleusine coracana* L. Gaertn). The sowing methods as main-plot treatment comprised of broad casting, line sowing and transplanting, whereas weed control practices (five) as sub-plot treatments comprised of isoproturon 0.5 kg/ha and oxyflourfen 0.5 kg/ha as pre-emergence and 2,4-D 750 g/ha applied at 25 days after sowing, weed free and weedy check. The highest yield attributes and yield were recorded under transplanting followed by line sowing. Minimum weed density and dry matter accumulation was found under transplanting. Among the methods of weed control, isoproturon 0.5 kg/ha gave excellent control of weeds and increased the yield attributes, yield, gross returns and B:C ratio.

Key words : Crop establishment, finger millet, weed management, herbicides.

Finger millet is the most important small millet grown in India and it serves as a subsistence and food security. It is important for its nutritive and cultural value in low input cereal-based farming systems on upland crop. Poor crop stand, poor physical conditions of major cereals lead to uncertainty of bumper harvest. Finger millet is well fitted crop under scarce rainfall but methods of crop establishment are not tested with scientific manner to withstand with vagaries of climate in the rainfed system. Under such condition, sowing of finger millet is often a problem for farmers during *kharif* when rainfall occurrence is quite uneven due to variation in distribution. Infestation of weeds deprives the crop plant from nutrients grown on uplands and drains the farmer's economy. To overcome above problems crop establishment methods of finger millet is emerging as an important challenge. Under such circumstances, the adoption of proper crop establishment methods and weed management practices can raise finger millet productivity and profitability.

With the introduction of high yielding varieties having demand of inputs, the problem of weed infestation has increased manifold as it created favorable conditions for invasion as well as luxuriant growth of weeds particularly of *Celosia argentia, Borreria hispida* and *Setaria glauca* throughout finger millet growing season (Pradhan and Singh, 2009). In finger millet, yield losses due to weeds may range from 20-82% depending upon the density, species of weed, duration of infestation and competing ability with crop plants under different agro-ecological condition (Pradhan *et al.*, 2010). Conventional methods of weed control being weather dependent, time consuming and costly due to high cost of labour and mechanical means being less efficient in controlling weed compare to use of herbicides. Under such circumstance, it is important to find out the economical ways of finger millet cultivation with herbicides under suitable crop establishment methods.

Materials and Methods

A field experiment was conducted at S.G. College of Agriculture and Research Station, Jagdalpur under All India Coordinated Small Millets Improvement Project during ***kharif*** season 2011 and 2012. Soil was sandy loam, low in organic carbon (0.44%), available N (177 kg/ha) and medium in available P (19.5 kg/ha) and available K (178 kg/ha) with acidic (pH 6.7) in reaction. Experiment was conducted in split-plot design with 4 replications involving sowing methods as main plot treatments comprised of broadcasting, line sowing and transplanting, whereas weed management practices comprised of five treatments viz., isoproturon 0.5 kg/ha (Pre-emergence), oxyflourfen 0.5 kg/ha (Pre-emergence), 2,4-D 750 g/ha (as post-emergence at 25 DAS), weed free and weedy cheek were accommodated in subplot. In broadcasting, no machine was used, whereas in line sowing two pass of cultivator till sowing followed by leveling was done to maintain seeding depth properly. Broad casting plots were directly sown by manual process of hand throwing. In case of line sowing, drill was used at the row-to-row spacing of 30 cm. Transplanting was done using 25 days old seedlings with maintaining spacing of 30 cm row to row and 8 cm plant to plant. The crop was sown on June 25th during both the years using finger millet variety 'GPU 28' at the seed rate of 12 kg/ha. The crop was fertilized uniformly with 60 kg N/ha through urea, 40 kg P_2O_5 /ha through single super phosphate and 20 kg K_2O/ha through muriate of potash. Pre-emergence herbicides viz., isoproturon 0.50 kg/ha and oxyflourfen 0.5 kg/ha were incorporated in soil; 2,4-D 750 g/ha was applied at 25 days after sowing using 500 liters of water/ha, with manually operated knapsack sprayer.

Weed density was recorded by using a quadrate of 100 cm × 100 cm (1 m^2) size from center of the plot. The total numbers of weeds falling within quadrate were counted species wise in each plot. The entire weed inside the quadrate were uprooted and cut close to the transition of root and shoot in each plot and collected for dry matter accumulation. The samples were first dried in sun and then kept in oven at 70° ± 2°C. The dried samples were weighed and expressed in g/m^2. Weed control efficiency was calculated at 45 DAS considering weed dry matter and expressed in per cent. A net return, gross returns and Benefit: cost ratio for each treatment combination was calculated. Pooled data of two years are presented in the tables. The data on weeds were collected gone through the square root transformation $\sqrt{X} + 0.5$ for statistical analysis (Panse and Sukhatme, 1967).

Results and Discussion

Effect on weeds

Sowing methods of finger millet had marked effect on weed density, weed dry matter accumulation and weed control efficiency. The major weed species present in the experimental field were *Celosia argentia, Borreria hispida, Setaria glauca, Eragrostis tenella* and other weeds. The effect of different sowing methods on the density of *Celosia argentia* was non significant during both the years. Density of weeds in broad casting was higher than transplanting and line sowing (Table 1). In case of dry matter accumulation, similar trends were found as density. It might be due to the fact that *Celosia argentia* seeds are smooth seed coat which could not be affected to seed bank, come to upper soil layer at the time of field preparation and get germinated in conducive environment. Similar findings were also reported Bisen *et al*. (2006). The higher dry matter accumulation of weeds was under broad casting and almost similar to line sowing (Table 1). It may be due to lower density of crop plants and more competition of weed plants and crop. The dominance of *Celosia argentia* in the field suppressed the others weeds. Density of *Borreria hispida* and others weed did not varied significantly, maximum weed density and dry weight was found under broad casting followed by line sowing and transplanting. These results are similar to the findings of Pradhan and Patil (2010).

Table 1. Density and dry matter accumulation of different weeds at 45 days after sowing as influenced by various crop establishment methods and weed management practices in finger millet (Pooled data of two years)

Treatmen	Density of weed (No. per m^2)					Dry matter accumulation of weed (g per m^2)				
	Celosia argetnia	*Borreria hispida*	*Setaria glauca*	*Eragrostis tenella*	Others	*Celosia argetnia*	*Borreria hispida*	*Setaria glauca*	*Eragrostis tenella*	Others
Broadcasting	19.92 (4.53)	18.85 (4.39)	17.97 (4.36)	18.77 (4.39)	18.25 (4.33)	17.48 (4.24)	17.62 (4.26)	17.31 (4.22)	17.29 (4.22)	17.52 (4.24)
Line sowing	20.07 (4.48)	18.52 (4.36)	18.12 (4.32)	18.35 (4.34)	17.90 (4.29)	17.40 (4.23)	17.39 (4.23)	17.17 (4.20)	17.16 (4.20)	17.35 (4.22)
Transplanting	15.08 (3.95)	15.07 (3.95)	15.09 (3.95)	15.06 (3.94)	15.07 (3.95)	15.03 (3.94)	15.02 (3.94)	15.05 (3.94)	15.04 (3.94)	15.06 (3.94)
SEm±	0.02	0.01	0.01	0.01	0.02	0.00	0.01	0.01	0.01	0.01
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed free	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
Weedy check	28.87 (5.42)	27.58 (5.30)	25.12 (5.06)	25.91 (5.14)	24.20 (4.97)	21.44 (4.68)	21.51 (4.69)	21.08 (4.65)	21.32 (4.67)	21.94 (4.74)
Isoproturon 0.5 kg/ha	17.20 (4.21)	16.79 (4.16)	16.37 (4.11)	16.53 (4.13)	16.33 (4.10)	16.69 (4.15)	16.65 (4.14)	16.47 (4.12)	16.39 (4.11)	16.43 (4.11)
2,4-D 750 g/ha	16.57 (4.14)	17.20 (4.21)	17.03 (4.19)	17.08 (4.19)	16.75 (4.15)	16.83 (4.16)	16.92 (4.17)	16.59 (4.13)	16.51 (4.12)	16.61 (4.14)
Oxyflourfen 0.5 kg/ha	18.37 (4.34)	17.74 (4.27)	17.45 (4.24)	17.41 (4.23)	17.16 (4.20)	16.93 (4.17)	17.12 (4.20)	16.77 (4.16)	16.70 (4.15)	16.78 (4.16)
SEm±	0.02	0.02	0.03	0.02	0.02	0.00	0.01	0.00	0.00	0.01
CD (P=0.05)	0.07	0.05	0.08	0.06	0.05	0.01	0.03	0.01	0.01	0.03

*Figures in brackets denote transform values.

Weed control efficiency was higher in transplanting followed by line sowing and broad casting at 45 days after sowing during both the years (Table 3). It may be due to higher soil manipulation, lower germination of weeds, and vigorous growth of crop and suppression effect of crop plants on weeds (Sinha and Singh, 2005).

Weed control measures had significant effect on weed population and its dry matter accumulation. The isoproturon treatment was effective to control the weeds viz. *Celosia argentia, Borreria hispida, Setaria glauca, Eragrostis tenella* and other weeds. In general weed density reduced after execution of weed control measures prior the crop germinates killed weed completely. Application of isoproturon 0.5 kg/ha resulted significantly lower weed density and dry matter accumulation of weeds (Table 1). It was effective than 2,4-D 750 g/ha to control weeds.

Yield and its attributes

Grain and straw yields was significantly higher in transplanting over broadcasting it remained at par with line sowing during both the years. The similar trend was recorded for straw yield during both the years. Higher grain and straw yield is the result of higher yield attributes associated with transplanting (Table 2). Line sowing also resulted into considerably better yield contributing characters thereby yielded higher over broad casting. These results are in conformity with the finding of Pradhan and Sonboir (2009).

Straw and grain yields were affected significantly by various weed management practices. The higher grain yield was observed under weed free treatment. However, isoproturon 0.5 kg/ha was second most effective treatment just after weed free treatment. This may be as a result of yield contributing characters, lesser number of weeds and better nutrient availability to crop as reported by Bisen *et. al*. (2008). Higher straw and grain yields under weed free and isoproturon 0.5 kg/ha treatment may be owing to efficient control of weeds, reduced crop-weed competition for nutrient, water, space and light and resulted in better growth, yield attributes and finally yields. Whereas, in weedy plot the vigorously growing weeds competed with the crop plant for nutrient, moisture, space and sunlight throughout growing period and finally suppressed the crop growth (Chhokar *et al*., 2007).

Among the yield attributes viz., finger length, number of fingerlets per finger, number of grains per finger and 1000 grain weight, the finger length under transplanting was significantly higher than broad casting and was found at par with line sowing during both the years (Table 2), which showed its superiority over broad casting for most of the yield attributes (Samui *et al*., 2004). Superiority of transplanting might be due to better suppression of weeds by placement of seedlings and space for finger millet and further weeds were suppressed by herbicides. Such parameters were not favourable in reducing weeds, which were

Table 2. Yield attributes as influenced by crop establishment methods and weed management practices (Pooled data of two years)

Treatment	Yield attributes			
	Finger length (cm)	No. of grain/ fingerlet	No. of fingerlets/ finger	1000 grain wt (g)
Line sowing	6.13	270.59	7.11	6.80
Broadcasting	4.43	267.29	6.51	6.50
Transplanting	6.33	273.19	7.51	6.92
SEm+_	0.28	0.85	0.13	0.03
CD (P=0.05)	0.86	2.60	0.40	0.11
Weed free	6.43	265.39	8.31	6.20
Weedy check	5.33	274.29	5.11	6.40
Isoproturon 0.5 kg/ha	6.13	272.29	7.51	6.60
2,4-D 750 g/ha	5.83	269.09	6.61	6.30
Oxyflourfen 0.5 kg/ha	6.03	270.59	7.11	6.24
SEm+_	0.02	1.06	0.26	0.10
CD (P=0.05)	0.06	3.18	0.81	0.31

Table 3. Weed control efficiency, straw yield, grain yield and economics as influenced by various crop establishment methods and weed management practices in finger millet (Pooled data of two years)

Treatment	Weed control efficiency at 45 days	Straw yield (t/ha)	Grain yield (t/ha)	Harvest index (%)	Cost of cultivation (x 103 Rs/ha)	Net Return (x 103 Rs/ha)	B:C ratio
Line sowing	72.92	4.57	2.63	36.53	24.23	29.33	1.16
Broadcasting	69.14	4.26	2.05	32.49	20.29	20.53	1.02
Transplanting	71.12	4.72	2.80	37.23	29.02	37.59	1.29
SEm±	0.57	0.04	0.05	1.58	-	-	-
CD (P=0.05)	1.81	0.15	0.17	NS	-	-	-
Weed free	100.00	5.02	2.88	36.46	30.84	36.16	1.53
Weedy check	0.00	3.53	1.60	31.29	20.16	14.84	0.21
Isoproturon 0.5 kg/ha	83.50	4.79	2.77	36.64	26.78	37.38	1.77
2,4-D 750 g/ha	80.84	4.70	2.60	35.62	26.47	36.16	1.73
Oxyflourfen 0.5 kg/ha	78.48	4.56	2.63	36.58	26.67	33.92	1.61
SEm±	0.86	0.11	0.08	1.78	-	-	-
CD (P=0.05)	2.60	0.33	0.28	NS	-	-	-

problem for initial growth and reflected by lower crop growth and development. Similar findings were reported on yield attributes by Rawat and Varma (2006).

Yield attributes were significantly arrested by weed control measures. Weed free treatment had statistically higher finger length, number of grains/finger, number of fingerlets/finger and 1000 grains weight over rest the treatments. The second next best performer was isoproturon 0.5 kg/ha over rest of the treatments (Table 2). The higher number of attributes may be result of good crop growth parameter, better nutrient availability and absence of weeds. Among the herbicides, isoproturon 0.5 kg/ha had capacity to control the grassy as well as broad leaved weeds. However, poor yield attributing character in oxyflourfen 0.5 kg/ha may be the result of less weed suppression and presence of weeds as described by Banga *et. al*. (2003).

Economics

Economic reveals that high cost of cultivation and gross return were found in transplanting followed by line sowing (Table 3). Net returns and B:C ratio was higher in transplanting followed by line sowing and broad casting. This may be due to higher yield obtained under treatment imposed. In case of weed management practices, higher cost of cultivation, gross returns, net returns and B:C ratio were found under isoproturon 0.5 kg/ha treated plots followed by 2,4-D 750 g/ha and oxyflourfen 0.5 kg/ha treated plots (Table 3) due to cost of 2,4-D. This may be due to excellent arresting capacity of grassy and non-grassy weeds by in combination of transplanting with application of isoproturon 0.5 kg/ha was found effective to manage weeds and increase finger millet grain yield.

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