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EFFECT OF DIFFERENT METHODS OF CROP ESTABLISHMENT AND WEED CONTROL MEASURES ON LITTLE MILLET (*PANICUM SUMATRENSE*) UNDER RAINFED CONDITION

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ABSTRACT
A field experiment was conducted at Instructional Farm, College of Agriculture, Rewa, Madhya Pradesh to find out the effect of different methods of crop and weed control measures on growth, yield attributes and yield of little millet (*Panicum sumatrense*). The results of two years study showed that sowing of little millet crop by providing wider row to row and plant to plant spacing and sowing of sunnhemp in between little millet rows which was later harvest at 20 DAS and used as mulch proved significantly superior over other methods of sowing. Among the options of controlling weed, Integrated weed control (Herbicide + One hand weeding at 25 DAS) was found most effective in controlling weed. Major weeds like *Cyperus irria* decreased from 31.47 to 6.03/m^2, Cynodon *dactylon* from 25.38 to 3.38/m^2 and *Echinochloa crusgalli* from 25.38 to 3.38/m^2 up to 30 DAS stage. The WCE was up to 78.31%. Out of different methods of crop establishment, M_2 brought about significantly higher grain yield (10.49 q/ha), straw yield (29.09 q/ha) as well as harvest index (26.08%) over the remaining establishment methods

INTRODUCTION

Among small millets, little millet (*Panicum sumatrense*) is an important crop of the tribal inhabitant belt of the state. Little millet is mainly grown on marginal lands with poor management practices hardly involving any weeded control method which results in significant reduction in yield of little. Major problem in marginal fields, under little millet cultivation, is huge infestation of weeds. Weeds compete for nutrients, moisture and space causing considerable yield reduction (Singh and Reddy, 1998).The weed population in cultivated fields has increased many folds as with the use of new and high yielding crop varieties having high demand for nutrients the favourable conditions for weed growth are also created (Verma, 2001). The way in which the crop is sown or established in field are ages old and are not tested with scientific manner to withstand the vagaries of climate change. Pradhan *et al*. (2010) reported that weeds cause appreciable loss in yield and depletes nutrients. Method of crop establishment is an important practice of weed control, even if once chemicals for control enter the picture, so such methods must be integrated with chemicals into the over-all scheme of operation (Mahajan, 2015). Therefore, integration of different weed control measures to reduce dependence on herbicides and to find out the economical way for little millet cultivation is need of time. Keeping these points in view, present investigation was made to evaluate the impact of different methods of crop establishment and weed control measures on weeds as well as little millet crop.

MATERIALS AND METHODS

The field experiment was conducted during *Kharif* seasons of 2013 and 2014 at Research Farm of College of Agricultural, JNKVV, Rewa, Madhya Pradesh. Rewa is situated in the North eastern part of Madhya Pradesh at 20º21′ North latitude, 81° 15′, East longitude and 365.7 meters above sea level. Total annual rainfall is about 980 mm (39 inches) and more than 80% generally occurs during the monsoon season (June-September).The soil of the experimental field was mixed red and black with clay loam in texture and slightly alkaline in reaction with pH 7.7, EC 0.32 dS\m having organic carbon 0.61 per cent and available nitrogen 270 kg\ha, phosphorus 16.4 kg\ha and potassium 352 kg\ha at 0-15 cm soil depth. The experiment was laid out in split block with three replications. The experiment consisted total of sixteen set of treatments. The main plot treatment consisted of different methods of establishment which included use of higher seed rate i.e. 12 kg/ha (M_1), Providing wider row to row (45cm) and plant to plant spacing (7.5 cm) for little millet and introduce sunnhemp in between little millet (22.5 cm) rows and harvest sunnhemp at 20 DAS and use as mulch (M_2), Delayed sowing by 10 days after normal time of sowing, though land is ready for sowing skip sowing during the 1st spell of sowing rains-harrow the field to uproot the weeds and then go for sowing (M_3) and Conventional practices(M_4) i.e. sowing of crop using seed rate of 10 kg/ha with spacing of 22.5 cm x 7 cm. whereas, sub plot treatment consisted of weed control measures *viz*: Control (W_1), Two hand weeding (25 & 50 DAS) (W_2), Use of

pre emergent herbicide (Isoproturon @ 0.5 kg a.i./ha) (W_3) and Integrated weed control (Herbicide + One hand weeding at 25 DAS) (W_4). A uniform dose of 20 kg P_2O_5/ha was applied through single super phosphate. The 40 kg N/ha was applied through urea in three split doses. Half dose of N and full doses of P was applied as basal just before sowing the crop and remaining half dose of N was applied in two equal splits i.e. at active tillering and panicle initiation stage of the crop. The other agronomical cultural practices such as irrigation and plant protection measures have been performed as per requisite. The crop was harvested manually at the maturity and the grain and straw yields were recorded. For weed studies, weed dry weight was recorded (at 30 days stage) from 0.25 m^{-2} areas by placing a quadrate of 0.5 $\times$ 0.5 m randomly at three places in border rows of each plot. A total number of weeds enclosed in each quadrate were identified species wise and counted. Final data was expressed as number of weeds per square meters. Weed control efficiency was calculated at maximum growth stage of crop *i.e.* 30th day stage by using the formula USDA/ICAR (AICRPWC, 1994).The original values were subjected to square root transformation (Y = "x + 1) for statistical analysis (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect on weeds

The major weed species present in the experimental field were *Cyperus irria, Cynodon dactylon, Echinochloa crusgalli* and others. Both the methods of establishment of crop and weed control measures had significant effect on weed density of different species of weeds and total weed dry weight.

Population density of weeds was found to be highest under conventional sowing without adoption of any improved technique (Table 1). Weed density of all the species of weed reduced significantly when crop was sown by adopting wider spacing and sowing of sunnhemp as green manure crop between the inter row spaces, which was later turned down in field at 20 DAS. Using of green manure crop not only suppresses the weeds but also add nutrients to soil which help in crop growth (Bhurer *et al.*, 2013). Total weed dry weight was in direct proportion to weed density *i.e.* lesser the weed density, lesser was the total weed dry weight and vice-versa. While working in finger millet crop, Pawar *et al.*, (2014) were also of same opinion. Significantly highest weed control efficiency was observed in M_2 method of crop establishment. However, it was at par with delayed sowing of crop (M_3). Kumar *et al.*, 2011 also made similar observation in millets crop.

Effect on crop

All the methods of crop establishment and weed control measures had a significant effect on growth and yield attributes of crop during both the years of study (Table 2). Amongst the methods of crop establishment, M_2 (wider spacing and use of sunnhemp for green manuring) recorded significantly maximum plant height whereas the conventional practice of sowing recorded the minimum plant height. This might be owing to availability of proper space between plants accompanied by nutrient availability on the decomposition of green manure crop and less weed competition. The present findings corroborate with those of Awasthy *et al.* (2014).

The mean data of two experimental years revealed significantly higher number of tillers /m row length, number of panicle/m row length and number of grains/panicle under M_2 methods of crop establishment, whereas, test weight of grains was not effected significantly. Among the measures of weed control, W_4 (Isoproturon + one hand weeding) proved significantly superior in terms of all growth and yield attributing characters except test weight of grains. It was due to the fact that pre-emergence isoproturon controlled the weeds from the very beginning, reducing crop-weed competition for nutrients, moisture, space and light. This was followed by hand weeding which controlled the remaining and emerging weeds and created favorable conditions for crop growth by improving soil aeration and water holding capacity. The present results agree with those of Pradhan *et al.*, 2014).

Effect on yield

Yield is the final expression of all the physiological and biochemical processes going on during the crop life cycle and has a direct relationship with the growth and yield attributing characters of plants. Out of different methods of establishment, well specified spacing with sunnhemp mulch (M_2) brought about significantly higher grain yield

Table 1: Weed density, total weed dry weight and weed control efficiency at 30 days after sowing as influenced by methods of crop establishment and weed control measures in little millet

Treatments	*Density of weeds*/m^2*				Total weed dry weight ($g\ m^{-2}$)	WCE (%)
	Cyperus irria	*Cynodon dactylon*	*Echinochloa crusgalli*	*Others*		
Methods of establishment						
M_1 = Use of higher seed rate(12 kg/ha)	4.73 (22.88)	4.72 (22.99)	4.15 (17.67)	3.57 (14.04)	6.99	28.70
M_2 = 45 cm x 7.5 cm spacing + sunhemp mulching	4.32 (18.93)	4.28 (18.88)	3.77 (14.63)	3.37 (11.89)	10.78	40.06
M_3 = Delayed sowing	4.57 (21.33)	4.57 (21.83)	4.02 (16.91)	3.51 (12.88)	8.54	33.04
M_4 = Conventional practices	4.99 (25.53)	4.91 (25.18)	4.45 (20.13)	4.00 (17.71)	5.61	30.49
C.D. (p = 0.05)	0.10	0.06	0.11	0.10	0.71	5.23
Weed control measures						
W_1 = Control	5.69 (31.47)	5.65 (31.13)	5.12 (25.38)	5.11 (25.26)	12.16	0.00
W_2 = Two hand weeding (25 & 50 DAS)	2.66 (6.03)	2.30 (4.36)	2.06 (3.38)	3.15 (9.00)	2.51	78.31
W_3 = Isoproturon	5.27 (26.80)	5.23 (26.41)	4.66 (20.73)	4.66 (20.89)	8.49	25.67
W_4 = Isoproturon + One hand weeding	5.02 (24.36)	5.29 (26.99)	4.56 (19.85)	3.52 (11.37)	8.76	28.29
C.D. (p = 0.05)	0.09	0.10	0.13	0.10	0.53	3.32

*Data transformed to "$\times$ + 1. Figure in parentheses indicate original values

Table 2: Growth and yield attributes as influenced by methods of crop establishment and weed control measures in little millet

Treatments	Plant height (cm)	Number of tillers /m row length	number of panicle/m row length	Number of grains/ panicle	Test weight of grains (g)
Methods of establishment					
M_1 = Use of higher seed rate(12 kg/ha)	33.88	83.25	34.67	630.33	4.00
M_2 = 45 cm x 7.5 cm spacing + sunnhemp mulching	38.03	92.50	41.12	743.67	4.55
M_3 = Delayed sowing	35.57	85.75	38.11	664.00	4.00
M_4 = Conventional practices	31.10	81.58	32.33	617.67	3.99
C.D. (p = 0.05)	1.21	1.60	0.15	4.26	NS
Weed control measures					
W_1 = Control	31.82	82.58	33.87	622.58	3.93
W_2 = Two hand weeding (25 & 50 DAS)	34.63	85.75	34.87	633.42	4.02
W_3 = Isoproturon	34.98	86.75	39.32	678.75	4.10
W_4 = Isoproturon + One hand weeding	37.16	88.00	40.89	720.92	4.52
C.D. (p = 0.05)	1.04	1.47	0.08	4.00	NS

Table 3: Grain yield, straw yield and harvest index as influenced by methods of crop establishment and weed control measures in little millet

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Harvest Index (%)
Methods of establishment			
M_1 = Use of higher seed rate(12 kg/ha)	6.76	27.28	19.67
M_2 = 45 cm x 7.5 cm spacing + sunnhemp mulching	10.49	29.09	26.08
M_3 = Delayed sowing	8.13	28.12	22.22
M_4 = Conventional practices	4.99	26.42	15.68
C.D. (p = 0.05)	1.00	1.08	1.83
Weed control measures			
W_1 = Control	5.70	26.99	17.07
W_2 = Two hand weeding (25 & 50 DAS)	7.49	27.64	20.99
W_3 = Isoproturon	7.46	27.88	20.47
W_4 = Isoproturon + One hand weeding	9.72	28.40	25.13
C.D. (p = 0.05)	0.74	0.58	1.55

(10.49 q/ha), straw yield (29.09 q/ha) as well as harvest index (26.08%) over the remaining establishment methods. Amongst the weed management practices, application of isoproturon combined with one hand weeding (W_4) proved the most beneficial which produced the significantly higher grain (9.72 q/ha) and straw (28.40 q/ha) with harvest index upto 25.13%. This was, however, equally followed by weed management treatments having two hand weeding (W_2) or isoproturon only (W_3). The control (weedy) treatment brought about the significantly lowest productivity parameters. All these weed management treatments reacted exactly in accordance with the growth and yield-attributing characters brought out by these treatments. The most advantageous factor associated with W_4 treatment was that the isoproturon controlled the weeds from the very beginning of the plant growth and thereafter control of further emerging or remaining weeds was monitored by following the hand weeding, thus providing the almost weed-free condition for the actively growing crop plants. These results are in close agreement with those of Verma and Midha (2007).

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