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Effect of integrated nutrient management and weed control measures on weed dynamics in pearlmillet (*Pennisetum glaucum* L.)

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Abstract
A field experiment was conducted at Research farm, Vivekananda Global University, Jaipur during *kharif*, 2024 on loamy sand soil. The experiment comprises 6 treatments of nutrient management practices (Control, 100 % RDF (60 kg N + 30 kg P_2O_5), 100 % RDF + FYM 10 t ha^{-1}, 75 % RDF + FYM 10 t ha^{-1}, 75 % RDF + FYM 10 t ha^{-1} + Bio-fertilizer (Azospirillum and PSB), 50 % RDF + FYM 10 t ha^{-1} + Bio-fertilizer (Azospirillum and PSB) and three treatment of weed control measures (Weedy check, Weed free and Atrazine @ 500 g ha^{-1} (PE) thereby experiment was laid out in randomized block design and replicated thrice. Results showed that application of Atrazine@500 g ha^{-1} (PE) treatment resulted significant reduction in weed density, weed dry matter in comparison to most of the treatments while highest weed control efficiency and lowest weed index was recorded with the same treatment except weed free.

Keywords: Pearl millet, nutrient management, bio-fertilizers, weed control, yield

Introduction
Pearl millet is well adapted to drought, low soil fertility and acidic soil conditions (Choudhary *et al*., 2014) [4]. Globally, it ranks sixth in terms of area and shares 42 percent of total world production (Patel *et al.*, 2014) [10]. It is grown on large scale due to its drought escaping mechanism and lower water requirement as compared to other cereals like sorghum and maize (Meena and Gautam, 2005) [8]. It is adopted to stress intensive environment, versatile, input responsive and high quality cereal with great potential to become a valuable component of non-traditional season like summer under irrigated and high input management conditions. The main reason for low productivity is crop raised under rainfed conditions on low fertility soils. Though various breeding efforts in pearl millet have produced agronomical elite cultivars-both hybrids and varieties with high yielding potential, their adoption has been low in arid areas.

Poor soil fertility and weeds are the most important constraints to crop production. Soil fertility management *i.e*., nutrient management particularly nitrogen (N) and Phosphorous plays a major role in increasing production and productivity of pearl millet. Nitrogen is an essential major nutrient for plant growth, which is closely associated with vegetative growth and development of plants. It plays an important role in plant metabolism by virtue of being an essential constituent of structural component of the cell wall and many metabolically active compounds. It is also a constituent of chlorophyll and amino acids, which is important for harvest of solar energy. It helps in early establishment of leaf area capable of photosynthesis. It promotes leaf and stem growth rapidly which consequently increase the yield and its quality. Nitrogen to some extent enhances the utilization of phosphorus and potassium. Nitrogen is most commonly deficient nutrient in Indian soil and gives considerable response in pearl millet crop (Jadhav *et al*., 2011) [5]. Pearl millet is an exhaustive crop, nitrogen is the major nutrient required by pearl millet and has shown variable growth and yield response to N application. Bio-fertilizers can be expected to reduce the use of chemical fertilizers and pesticides. The microorganisms in biofertilizer restore the soil's natural nutrient cycle and buildup soil organic matter.

Through the use of biofertilizers, healthy plants can be grown, besides enhancing the sustainability and the health of the soil. Inoculation of biofertilizers alone or in combination increase plant height, number of tillers and ultimately the yield and reduce the usage of chemical fertilizers to supply nutrient requirement usage of Biofertilizers has helped in reducing the recommended dose of chemical fertilizers needed for corn and millets by 50% without any loss in the yield (Pareek, 2016) [9].

One of the major constraints in pearl millet production is weed infestation. Weeds compete with crop for light, moisture and nutrients, with early season competition being the most critical (Asbil, 2001) [1]. Slow growth of the finger millet favours weed growth, which causes more competition for sunlight, nutrient and water in early stages of growth leading to low productivity. The critical period of crop - weed competition for the crops varies from 25-45 days after sowing (Lal and Yadav, 1982) [7]. Weeds emerge along with the crop during rainy season which cause serious competition with the crop plants during initial slow growth period resulting in seed yield loss upto 40% or more (Sharma and Jain, 2003) [12]. On an average, 55 per cent yield reduction due to heavy weed infestation in pearl millet crop was observed by Banga *et al*. (2000) [2]. Therefore it is imperative to control weeds at proper time with suitable methods to get high yield in pearl millet. At present, weeds are controlled by hand weeding twice at 25 and 45 days after sowing and hoeing. However, due to continuous rains during monsoon season it becomes difficult for manual weeding at right time. Furthermore, non-availability of labour and increasing labour charges and being time consuming, it was felt to find out suitable weed control methods involving herbicides. The pre emergence herbicides are effective only for about intial 30 days and thereafter weeds may threat pearl millet crop. Sometimes due to unavoidable circumstances, it is not possible to spray post emergent herbicides and later on it becomes very difficult to control the weeds manually. Under such circumstances, the best possible means to control new flush of weeds are through use of pre emergence herbicides. Weed control during early stages of crop growth period assumes important as revealed from the significant decrease in yield due to delay in weeding. The costly and laborious nature of manual weeding has made chemical weed control popular among farmers. To reduce the cost of finger millet production, intensive applications of weed control methods should be optimized. Therefore, determining appropriate weed management practices is important for production to ensure optimum grain yield. Identifying the critical period for weed control (CPWC) in crops is one of the first steps in designing a successful integrated weed management.

Materials and Methods

The experiment was conducted at Research farm, Vivekananda Global University, Jaipur. Geographically, is situated Geographically this place is situated at 750 47' East longitude, 260 51' North latitude and at altitude of 390 m above mean sea level in Jaipur district of Rajasthan. This region falls under Agro-climatic zone IIIa (Semi-arid eastern plain zone) of Rajasthan. The experiment consisting six treatments of nutrient management (Control, 100 % RDF (60 kg N + 30 kg P_2O_5), 100 % RDF + FYM 10 t ha^{-1}, 75 % RDF + FYM 10 t ha^{-1}, 75 % RDF + FYM 10 t ha^{-1} + Bio-fertilizer (Azospirillum and PSB), 50 % RDF + FYM 10 t ha^{-1} + Bio-fertilizer (Azospirillum and PSB) and three treatment of weed control measures (Weedy check, Weed free and Atrazine @ 500 g ha^{-1} (PE).

Weed studies

Weed population per metre square

Weed population was taken at 30 DAS from five random spots in each plot by counting the number of weeds per quadrate of 0.25 m^2 and the average was computed.

Weed Dry matter

Weed samples from five randomly selected spots in each plot were taken at 30 DAS with the help of 0.25m^2 (0.5 m x 0.5 m) quadrate and the average was worked out. The samples so collected were subjected to sundry for sufficient time, weighed and average was computed as dry matter kg/ha.

Weed Control efficiency (WCE)

In order to evaluate the weed management treatments for their efficacy, weed control efficiency of each treatment was computed by using the following formula.

$$WCE\ (\%) = \frac{DMC - DMT}{DMC} \times 100$$

Where,
DMC = Dry matter yield of weeds in weedy check plot
DMT = Dry matter yield of weeds in treated plot

Weed Index (WI)

Weed index is a derived parameter from the crop yields obtained across the treatments of weed control researches (Yadav and Mishra, 1982) [7]. It is a measure of the crop yield loss accrued across treatments in comparison to a weed free plot adopted in an experiment. Following formula was used in calculating weed index.

$$Weed\ Index = \frac{X - Y}{X} \times 100$$

Where,
X = Crop yield in weed free plots
Y = Crop yield in the treated plot

Results and Discussion

Weed-management practices significantly reduced the weed population and their dry weight as compared to weedy check plot. In case of weed species count and their dry weight, the lowest values were recorded with the application of Atrazine @500 gha^{-1}(PE) except of weed free plot. However, application of Atrazine @500 gha^{-1}(PE) also reduced the total weed population and dry weight of weeds as compared to weedy check. The superiority of these treatments could mainly be ascribed to the fact that application of herbicide alone inhibited the germination stage, Accelerated growth of crop due to looseness of soil and aeration in root zone incurred due to hoeing could be assigned as another reason of lower density and dry matter of weeds obtained under these treatments. These results corroborate the findings of Rao *et al*. (2007) and Changseluk (2003) [11].

There was a great variation in the extent to which the weeds were controlled by different weed management treatments.

The maximum weed control efficiency and visual control of 100% at all stages was recorded under weed free treatment. The lower weed index values under aforesaid treatment are attributed to the reduced competitional stress by weed. Inhibition of germination of weeds and their growth following application of different herbicides might have reduced the growth of weeds through arresting cell division and elongation and thus causing mortality of weeds. These seem to be the most spectacular reasons of accumulating lesser dry weight of weeds and as a consequently the higher weed control efficiencies. Similar results were also reported by Kaushik and Shaktawat (2005) [6], Walia *et al*. (2007) [13], Rao *et al*. (2007) [11].

Table: 1: Effect of INM and weed control measures on weed dynamics in pearlmillet

Treatments	Weed population per metre square area	Weed dry matter per metre square area	Weed control efficiency (%)	Weed index
Factor- I Nutrient management	**At 30 DAS**	**At 30 DAS**		
Control	11.80	14.59	57.20	28.05
100 % RDF (60 kg N + 30 kg P_2O_5)	8.70	10.82	54.05	10.95
100 % RDF + FYM 10 t ha^{-1}	5.42	7.52	46.88	12.22
75 % RDF + FYM 10 t ha^{-1}	10.78	12.50	55.62	6.33
75 % RDF + FYM 10 t ha^{-1} + Bio-fertilizer (Azospirillum and PSB)	9.92	12.07	54.71	6.17
50 % RDF + FYM 10 t ha^{-1} + Bio-fertilizer (Azospirillum and PSB)	11.24	14.24	53.96	8.14
SEm+	1.47	1.61	2.47	3.37
CD (P = 0.05)	4.23	4.62	7.11	9.68
Factor- II Weed Control Practices				
Weedy check	21.45	26.72	0.00	28.17
Weed Free	0.00	0.00	100.00	0.00
Atrazine @ 500 g ha^{-1} (PE)	7.48	9.15	61.21	7.75
SEm+	1.04	1.14	1.75	2.38
CD (P = 0.05)	2.99	3.27	5.03	6.84

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