



Review Article

INTEGRATED WEED MANAGEMENT APPROACH FOR DIRECT SEEDED FINGER MILLET (*Eleusine coracana* L.)

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Abstract: Finger millet or *ragi* has the pride of place in having the highest productivity among small millets and ranks third among the nutri-cereals next to sorghum and pearl millet. The production and productivity of finger millet is low because of inefficient irrigation and nutrient management, heavy weed infestation, incidence of blast disease etc. Among these, weed infestation is a serious threat to its production. Uncontrolled weed growth during crop period has significantly reduced the grain yield ranging from 34 to 61 percent. The critical period for crop-weed competition is initial five weeks period from planting. Effective weed management is needed for accomplishment of higher yield. It warrants for timely weeding and intercultivation within the critical period. Suitable weed management strategies should be adopted to keep weeds under check and to harness maximum yield benefit from finger millet through integrated weed management approach.

Keywords: Direct Seeded Finger Millet, Integrated Weed Approach, Herbicide Application, Mechanical Method

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Introduction

In agriculture, worldwide yield loss is attributed to losses incurred due to occurrence of weeds, pests and diseases. It is estimated that around 33% yield loss is due to weeds alone in a tropical country like India where throughout the year there is availability of solar radiation & increased temperature where weeds offer severe competition for these resources. Indian agriculture is predominant with rainfed agriculture situation where in almost 80 percent of the crops are cultivated depending on the monsoon. As the tropical situation is associated with high temperature and the fertility status of our soils is low reflecting less availability of nutrients. Our soils are not only hungry but also thirsty, where there is a huge scope for weeds to compete for these scarce resources. Weeds are gifted with certain special characteristics (dormancy, dispersal & propagation mechanisms) which make their survival in soil possible over years. Adaptation to adverse climatic situations makes them a well verse competitor for nutrients, moisture, sunlight and space with the agriculturally important food crops. With the changing climate, water resources are becoming scarce therefore, it is essential to reduce the loss of moisture from evapo-transpiration by weeds. Weeds also act as alternate hosts for major pests & diseases in crops, weeds have to be kept under check for attaining sustainable yields and to fulfil the growing need for food by expanding population pressure. Finger millet (*Eleusine indica* L. Gaertn) is an important member of small millet group in rainfed tracks of the country. It is an important dry land crop due to its resilience and ability to withstand aberrant weather conditions and generally grown in soils having poor water supplying capacity and nutrients. It is commonly referred as *ragi* in Karnataka, is one of the major staple food of farming communities of southern Karnataka. It contains 9.2 % protein, 1.29 % fat, 76.32 % carbohydrate, 2.24 % minerals and 3.9 % ash besides vitamin A and B. The grains are rich in phosphorus, potassium and amino acid. It is also rich source of calcium (410mg/ 100g grain) for growing children and aged people [1-4]. It is nutritional superior when compared to rice and wheat. It is a high stature crop with slower initial growth which remains under smothering due to the infestation of weeds at early stages of growth.

Being C₄ plant it is a ray of hope in the changing climate scenario. Due to high plasticity with respect to type of soil, fertility status and low water requirement it is intensively grown by small and marginal farmers under rainfed situations by either drill sowing or broadcasting. Lower yields of finger millet can be attributed to yield loss by severe weed competition and incidence of blast disease. Weed flora has a very wide diversity within them; types of weeds species and its density directly influence the extent of yield loss in different crops. As the competing ability of these diverse weed floras are different, it is essential to have the knowledge about biology and ecology of weeds in order to manage them effectively. Crop, season, method of cultivation, climate, edaphic and biotic factors greatly influence the weed diversity and distribution. The major weed flora associated with finger millet under drill sown situation [5] were *Cyperus rotundus* L. (among sedge), *Digitaria marginata* (Retz), *Eragrostis pilosa* Beauv, *Dactyloctenium aegyptium* (L.) (among grasses), *Acanthospermum hispidum* D.C., *Cleome monophylla* L., *Polygonum plebejum* R.Br. In addition to these weeds, Finger millet was also found to be associated with *Echinochloa colona* L., *Echinochloa riparia* (wild), *Phyllanthus fraternus* Webster, *Oldenlandia corymbosa* L., *Commelina bengalensis* L., *Spillanthus acmella* Auct & *Emilia sanchyfolia* [1]. Occurrence of *Dicanthium annulatum* Staf, *Eleusine indica* Gaertn, *Mullago cervinia* L., *Portulaca oleracea* L., were observed when finger millet was cultivated under rainfed situation [6]. Similar findings have been reported by [7], [8] and [9]. *Cyanodon dactylon* L., *Panicum milliacea* L., *Dicanthium caricum* L., *Commelina bengalensis* L., *Stachytarpetta indica* L., *Borreria hispida*, *Trichodesma indica*, *Emilia sanchyfolia*, *Cardiospermum helicabum* L., *Polygonum plebejum*, *Amaranthus viridis* [10] are other major weeds associated with finger millet under rainfed situations. These are in conformity with the findings [11]. Adopting suitable weed management strategies weeds have to be kept under check to harness maximum yield benefit of finger millet. Finger millet being poor man's crop no serious production techniques are adopted to save the yield loss due to weeds. The present paper is being brought out with the available literatures in order to throw light on different weed management approaches in direct seeded finger millet.

Strategies for Successful Weed Management

The different approaches for weed management include preventive measures, cultural, mechanical and chemical methods.

Preventive measures

This is one low cost technology which can be adopted by any farmers. Preventive measures has to be adopted to avoid the entry of weed seeds onto the farm through one of these means i.e., manures, seeds or planting material, mulching material, farm implements, animals and water. These preventive measures also include implementation of some policy issues and quarantines.

1. Selection of good quality seeds preferably certified seed is one of the prime factors in managing the weeds. "One year seeding is seven years of weeding" if weed seeds once sown will take seven years to eradicate those seeds by weeding. Therefore, with the aim of reducing the weed seed bank relevance of the principle of "Prevention is better than cure" is a must.
2. The inundation of weed seeds can be checked without investing any extra money by using well decomposed manure/compost.
3. Practice of clean cultivation also aids as preventive measure in weed management. These preventive measures are low cost technologies which further reduce the menace of weeds during the cropping season.

Mechanical and cultural methods

The most effective means of controlling these weeds are by mechanical and cultural methods which are practically becoming difficult and uneconomical due to increasing demand for labour, high labour wages as an after effect of urbanization and industrialisation [12]. Several cultural practices like tillage, planting, fertiliser application, irrigation etc., are employed for successful cultivation of crops. Although, these practices alone cannot control weeds but when employed with other methods can be used as a tool for reducing weed population. In addition, to this selection of varieties, seed rate, time of sowing, spatial arrangement and manipulation of cropping system can also affect the weed growth. Higher seed rate and narrow spacing had greater ability on suppressing weeds by its negative effect on weed biomass and positive effect on crop biomass and yield [13]. Deep drilling may decrease the competitive ability of the crops against weeds [14]; hence depth of sowing should be taken care. Selection of fast growing cultivar makes its good competitive edge very strong. Similar findings are reported from [15]. Nutrient uptake by weeds in finger millet, were found to be lowest in hand weeding plots compared to others thereby making it available to crops and reduce the cost on excess nutrient application [16]. Off-season land management such as summer ploughing or raising green manure contributed to significant depletion of weed seed reserves in the soil and ultimately led to enhanced productivity of crops [17]. Through one deep summer ploughing desiccation of deep placed weed seeds, propagating materials viz., seeds, tuber's, stolen and other propagules may occur due to exposure to strong solar radiation thereby reducing the weed density in the upcoming cropping season. Conventional tillage (3 ploughings and 3 intercultivations) significantly reduced the population of weeds compared to reduced tillage (2 ploughings + 2 inter cultivations) and minimum tillage (1 ploughing + 1 inter cultivation) as in conventional tillage the inversion of soil resulted in deeper placement of weed seeds which could not emerge out, causing a significant reduction in the population of weeds. Satisfactory weed control in conventional tillage treatment may be attributed to the stimulatory effect of tillage in inducing weed seed germination and it might be due to the greater deposition of weed seed at soil surface and ploughing each time might kill the germinated weeds and which results ultimately in higher grain yield of finger millet (3030 kg/ha) as revealed by [18]. Among the different tillage practices, summer tillage recorded lower weed density and dry weight which led to higher grain yield, stover yield and harvest index of finger millet when compared to conventional and minimum tillage practices and in different conservation farming treatments using all four conservation farming techniques viz., opening of conservation furrow, intercropping of red gram with finger millet and use of herbicide recorded lower weed population and biomass thus enhancing the grain and stover yield of finger millet [19]. Stale seedbed technique with inter cultivation twice at 20 and 35 DAP followed by hand weeding twice at 20 and 30 DAP recorded the highest net return

and B: C ratio (Rs. 56,939 and 56,545/ha and 2.61, and 2.56, respectively) in Finger millet [20].

Chemical method

As an alternative, chemical weed management is the left out option which if wisely and scientifically used can be a successful management tool which manage the diverse weed flora and also proved to be economical. Herbicides provide the weed control at initial stage thereby providing crop an advantage of good growth from beginning there by providing competitive edge over the later emerging weeds. Among different herbicides, application of oxadiargyl 80 WP 80 g a. i. ha⁻¹ at 3 DAS followed by ethoxysulfuron 15 WG 12 g a. i. ha⁻¹ at 30 DAS recorded lower sedge, grasses, broad leaved and total weed density (3.33, 13.67, 12.33 and 29.33 m⁻², respectively), lower weed dry weight (1.47, 9.02, 5.55 and 16.04 g m⁻², respectively), lower weed index (-7.4 %), higher weed control efficiency (90.3 %) [21]. Application of butachlor at 0.75 kg/ha more or less gave similar grain yield (3.12 t/ha) to hand weeding twice (3.52 t/ha) due to good control of weeds [22]. [23] Butachlor application at 0.75 kg a.i.ha⁻¹ or 0.5 kg a.i.ha⁻¹ along with one hoeing recorded marginally higher grain yield of 36-38 q/ha due to lower weed density (10-13 m²) and dry weed biomass (0.9 to 1.05 q/ha) at harvest which resulted in weed control efficiency more than 85 per cent. Reduced weed competition led to utilization of resources efficiently which resulted in good growth and yield. The control of weeds was highest under pre-emergence application oxyfluorfen 0.50 kg/ha + two hand weeding at 20 and 45 DAS, followed by oxyfluorfen 0.25 kg/ha + two hand weeding at 20 and 45 DAS [24]. Oxyfluorfen, being broad spectrum herbicides supplemented by one or two hand weeding either 20 DAS and 45 DAS alone or in combination suppressed the weed growth for a longer period led to improvement in growth and yield parameters of finger millet. It might be attributed to the reduction in weed competitiveness with the crop. Application of isoproturon @ 0.5 kg pre-emergence +2,4-D Na salt @0.5 kg ha⁻¹ as post emergent and isoproturon @ 0.5 kg ha⁻¹ was found to be effective in managing weeds which was on par with that of hand weeding twice. [25]. Pre-emergence application of bensulfuron methyl + pretilachlor @ 3 kg/ha (pre-mix formulation) followed by one inter-culture at 45 DAS recorded reduced weed density and weed dry weight with higher weed control efficiency on par with that of weed free plot as reported by [26]. The enhancement of crop growth and yield attributes components could be due to less competition by the weeds for crop these factors throughout the crop growth period due to control of early emerged weeds before sowing through pre-emergence application of herbicides and late emerged weeds through inter-culture.

Conclusion

The area under finger millet is fast declining due to constraints existing in its cultivation whereas demand for finger millet is estimated to increase due to its nutritional importance and increasing diabetic population. One among the constraint in direct seeded finger millet being weed menace and higher labour wages for weeding leading to reduction in yield. Farmers generally control weed, manually which is costly, time taking and troublesome. Now-a-days herbicides are gaining popularity because of cheaper, selectiveness and effectiveness. Therefore, to enhance the area under finger millet cultivation problem of weed management has to be tackled by utilizing all possible options by integrated weed management approach through preventive measures, cultural, mechanical, biological and chemical methods.

Application of review: This paper on integrated weed management approaches for direct seeded finger millet has been reviewed to counteract the problem of weed menace in finger millet growing dry land areas through integration of physical, chemical and mechanical method of weed management practices.

Review Category: Crop Science

Abbreviations:

DAS = Days after sowing

Kg/ha = Kilogram per hectare

t/ha = Tonne per hectare
a.i. = Active ingredient
% = Percentage

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Study area / Sample Collection: AICRP on Small Millets, ZARS, V. C. Farm, Mandya, 571 405

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