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SUSTAINABLE MANAGEMENT OF WEEDS IN RAINFED EGGPLANT IN INDIA

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ABSTRACT

On-farm participatory experiments were conducted at Nalloor cluster comprising three villages viz. Keelakuruchi, Melakuruchi and Kattumailoor in National Agricultural Innovation Project implemented by Annamalai University in southern India. Grazing by goats in the off-season (March, April and May) was integrated with mulching of perennial crop wastes such as sugarcane trash and coconut husks in vegetable crop of eggplant (Solanum melongena L.) rose during June-September. Goat grazing supplemented control of Trianthema portulacastrum with a weed control index (27%), whereas, mulching with sugarcane trash offered 64% control of perennial weeds such as Cyanodan dactylon. Integrating both goat grazing and sugarcane trash mulching compared better than conventional practices of hand-weeding and herbicide treatments, in offering a sustainable weed control and favouring crop yields. A 21% enhancement in soil organic matter content was also achieved due to this integration.

Keywords: Sustainable weed management, rainfed vegetable, eggplant

INTRODUCTION

Brinjal (or) eggplant (*Solanum melongena* L.) of family Solanaceae is one of the most popular vegetables in households of India. It is widely distributed in tropical and temperate zones of China, Turkey, Syria, Iraq, Japan, Indonesia, Philippines, Thailand and Jordan. India being a centre of origin it is grown in almost all the states covering 6 lakh hectares with a production of 104 lakh metric tonnes during 2008 (Anon 2009). It is third most important crop in family of Solanaceae after potato and tomato (Anon 2000). Brinjal is a source of phosphorus (47 mg/100g) Carotene (74 µg) has 12mg/100g of vitamin C, as well as possessing some medicinal properties (Shukla and Naik, 1993).

Poor weed management in brinjal is most important factor limiting productivity which necessitates adoption of sound weed control measures at early growth stage. The problem of weeds has been particularly more acute because of tropical condition prevailing in

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India. The losses due to high weed infestation were estimated to be much more in vegetables as compared to cereals. Weeds compete with crop plants for different growth factors and significantly to cost of farm operations (Qasem, 2003; Zaragoza, 2003). Weed management is a major constraint in brinjal cultivation in India because it's a long duration crop and it is growth period coincides with monsoon season. In India, cultural methods of weed management are widely used by farmers but too much laborious, time consuming and expensive on account of scarcity of labour particularly during peak periods of labour demand which coincides with field operations in other crops. Moreover, hand weeding is not efficient because even with precise hoeing, weeds very often close to crop plants are not removed. Under these circumstances the option left for managing weeds is by using herbicides or combination of both herbicides and cultural practices. Weed control in vegetables have been reported with use of different herbicides (Patel *et al.*, 1986; Keeling *et al*., 1990). Pendimethalin applied at doses > 0.75 kg a.i./ha in some vegetable crops has not only provided good control of weeds but also effectively controlled specific and dominant weed taxa with widely varying growth forms (Rapparini, 1994). Herbicides treatment significantly reduced weed counts and weeds dry weight in chilli and carrot and weed nutrient uptake in chilli (Mukund *et al*., 1995; Kumar *et al.*, 1995).

Repeated use of herbicide may lead to reduction in crop growth and herbicidal resistance and hence integrated approach involving organic mulching, grazing with animals like goat/sheep are some of the options for sustainable weed control. Reduction of weed biomass was observed from 23.7 to 29.5% due to grazing of goats in off-season (Kathiresan, 2010). The present investigation was undertaken to study and compare the efficacy of grazing with goat. Hand weeding, chemical control with pendimethalin @ 1 kg a.i./ha and mulching with sugarcane trash and coir pith.

METHODS

The experiments were carried out in holdings of small and marginal farmers participating as development partners of National Agricultural Innovation Project Implemented by Annamalai University in the rainfed cluster (Nalloor) of Cuddalore district during 2008-09 and 2009-10. Nalloor cluster comprises of three villages *viz*., Keelakurichi, Melakurichi and Kattumailoor. One among the ten treatments was imposed in every farmers holding along with an untreated control and each of these were considered as a replication. As 50 farmers participated, five replications of 10 treatments were compared in a randomized block design.

Treatments

T_1 - Off season grazing + Un-weeded control
T_2 - Off season grazing + Hand weeding
T_3 - Off season grazing + Pendimethalin @1kg a.i./ha
T_4 - Off season grazing + Sugarcane trash mulching
T_5 - Off season grazing + Coir pith mulching
T_6 - Off season fallow + Un-weeded control
T_7 - Off season fallow + Hand weeding
T_8 - Off season fallow + Pendimethalin @1kg a.i./ha
T_9 - Off season fallow + Sugarcane trash mulching
T_{10} - Off season fallow + Coir pith mulching

Two goats were provided to the beneficiary under NAIP Project for grazing trails, these goats were allowed to graze in offseason (March, April and May) at morning and night. Hand-weeding, chemical control with pendimethalin @ 1 kg a.i./ha (Stomp Extra® 30% EC) and mulching of sugarcane trash and coir pith (also known as Coconut peat or Coir dust.) were adopted as per treatment schedule in 1000 m^2. Brinjal seeds were sown in a nursery and transplanted on 30th day. The regular cultural practises were followed except weeding. Hand weeding was done thrice on 25th, 50th and 75th day after transplanting, for herbicide application pendimethalin @ 1 kg a.i./ha was sprayed as pre-emergence on second day after planting. Mulching with sugarcane trash and coir pith @ 5 tonnes/ha were spread in the fields as per treatment schedule. Observations on the weeds present, weed count, weed biomass were recorded from four quadrates of 0.25 m^2 area at 45 & 90 DAP and data on 90 DAP is presented considering the space requirement. Weed Control Index (WCI) was also calculated using the formula suggested by Thakur (1994).

$$WCI = \frac{a-b}{a} \times 100$$

Where, a - weed biomass of unwedded plot

b - weed biomass of treated plot

Dry matter production and fruit yield per 1000m^2 were recorded and converted per hectare. Soil organic matter content was calculated based on Walkley black method expressed in percent (Dipak and Abhijit, 2005). Data were analysed using analysis of variance to draw the standard error differences and ultimately the critical difference was worked out at 0.5% probability as suggested by Panse and Sukhatme (1978).

RESULTS

Weed species found in selected experimental fields of Nallor cluster were *Cynodon dactylon, Cyperus rotundus, Chenopodium album, Amaranthus viridis, Trianthema portulacastrum, Phalaris minor, Phyllanthus niruri* and *Cleome viscose, Dactyloctenium aegypticum.*

Among these species, most abundant were *C. dactylon*, *T. portulacastrum* and *A. viridis* as they occur in frequent intervals in the trial fields. The rest of the weed flora listed were sporadic in occurrence. Integration of farming elements like offseason grazing of goats and mulching with sugarcane trash and coir pith significantly reduced individual weed numbers of three predominant weed species when compared with off season fallow and conventional weed control practices like hand weeding and application of pendimethalin (Table-1). In general, integration of offseason grazing with other super imposing treatments excelled better than treatments imposed on off season fallow fields. Among treatments, off season grazing + sugarcane trash mulching reduced individual weed count of all predominant weed floras. This treatment was on par with off season grazing + hand weeding in both years. The weed count of these three species was reduced in consecutive second year when goat grazing was practised in off season.

Table-1. Effect of goat grazing, mulching and chemical control on individual weed count in *S. melongena* L.

Treatment Details	*Cynodon dactylon* m^{-2}			*T. portulac-astrum* m^{-2}	*Amaranthus viridis* m^{-2}	
	2008-2009	2009-2010	2008-2009	2009-2010	2008-2009	2009-2010
Off season grazing + Un-weeded control	5.5 (30.1)	5.4 (28.5)	6.7 (45.3)	6.7 (44.2)	4.9 (24.3)	4.92 (23.6)
Off season grazing + Hand weeding	3.9 (15.3)	3.9 (14.8)	3.3 (10.4)	3.2 (9.9)	2.5 (6.1)	2.4 (5.5)
Off season grazing + Pendimethalin @1kg a.i. /ha	4.3 (16.7)	3.9 (15.0)	5.3 (27.5)	5.1 (26.1)	2.6 (6.5)	2.5 (6.0)
Off season grazing + Sugarcane trash mulching	3.8 (14.4)	3.7 (13.8)	3.1 (9.4)	3.1 (9.1)	2.3 (5.1)	2.3 (4.6)
Off season grazing + Coir pith mulching	4.2 (17.7)	4.1 (16.6)	5.2 (26.4)	5.1 (24.9)	2.7 (6.9)	2.6 (6.6)
Off season fallow + Un-weeded control	9.7 (95.1)	9.9 (98.5)	8.1 (65.1)	8.3 (68.2)	6.2 (38.3)	6.4 (40.6)
Off season fallow + Hand weeding	4.8 (23.4)	5.1 (25.6)	5.5 (30.4)	5.8 (33.1)	2.9 (8.4)	3.2 (10.0)
Off season fallow + Pendimethalin @1kg a.i. /ha	4.6 (21.5)	4.9 (23.7)	5.0 (25.0)	5.2 (27.1)	3.1 (9.3)	3.2 (10.2)
Off season fallow + Sugarcane trash mulching	4.7 (22.4)	5.0 (24.7)	8.3 (48.4)	7.1 (50.0)	3.3 (10.5)	3.4 (11.2)
Off season fallow + Coir pith mulching	5.01 (24.6)	5.2 (26.8)	7.1 (50.6)	7.2 (52.2)	3.5 (11.7)	3.7 (13.1)
Standard Error difference	0.1	0.1	0.1	0.1	0.1	0.1
Critical Difference(P=0.05)	0.2	0.2	0.2	0.2	0.2	0.2

Figures in parenthesis are original values

Results of individual weed numbers of predominant weed flora reflected in total weed count (Table-2). The total weed numbers was

significantly reduced in integration with offseason grazing when compared to integration with fallow fields. The least total weed count was observed in offseason grazing + sugarcane trash mulching (34.3 & 32.8 in 2008-2009 & 2009-2010, respectively). This treatment was on par with off season grazing + hand weeding. There was significant reduction in weed biomass due to integration of grazing with other conventional method. In grazing fields the weed biomass was reduced in consecutive second year where as in fallow fields the biomass was enhanced irrespective of super imposing treatments. The least biomass observed in offseason grazing + sugarcane trash mulching was significantly higher than next best treatment of off season grazing + coir pith mulching. The weed control index (WCI) was enhanced to greater level of 89.1 & 89.8 in the first and second years, respectively in offseason grazing + sugarcane trash treatment. However, in offseason fallow + sugarcane trash mulching the WCI observed was much lower which was at par with off season fallow + hand weeding.

Table-2. Effect of goat grazing, mulching and chemical control on weed numbers, biomass and control index in *S. melongena* L.

Treatment Details	Total weed numbers m^{-2}		Weed biomass m^{-2}		Weed control index	
	2008-2009	2009-2010	2008-2009	2009-2010	2008-2009	2009-2010
Off season grazing + Un-weeded control	11.6 (135.4)	11.3 (128.2)	114.4	110.6	38.7	44.1
Off season grazing + Hand weeding	5.9 (35.1)	5.7 (33.0)	28.6	27.2	84.6	86.2
Off season grazing + Pendimethalin @1kg a.i./ha	6.2 (38.1)	6.0 (36.0)	34.2	30.6	81.6	84.5
Off season grazing + Sugarcane trash mulching	5.9 (34.3)	5.7 (32.8)	20.3	20.1	89.1	89.8
Off season grazing + Coir pith mulching	6.0 (36.1)	5.8 (34.2)	23.4	22.6	87.4	88.5
Off season fallow + Un-weeded control	14.5 (210.3)	15.1 (228.2)	186.7	198.2	-	-
Off season fallow + Hand weeding	7.9 (63.4)	8.1 (65.8)	57.3	59.8	69.2	69.8
Off season fallow + Pendimethalin @1kg a.i./ha	8.1 (65.1)	8.2 (67.2)	59.4	63.7	68.1	67.8
Off season fallow + Sugarcane trash mulching	8.1 (65.7)	8.3 (68.6)	58.4	60.5	68.6	69.4
Off season fallow + Coir pith mulching	8.3 (69.7)	8.5 (72.1)	60.8	62.6	67.4	68.3
Standard Error difference.	0.1	0.1	0.4	0.5	0.6	0.5
Critical Difference(P=0.05)	0.2	0.2	0.9	1.1	1.3	1.2

Figures in parenthesis are original values

The yield of *S. melongena* was significantly increased due to integration of farming elements like goat grazing and organic mulching (Table-3). In general dry matter production (DMP) and fruit yield were recorded higher when offseason grazing was practised with super imposing weed control treatments. Highest DMP (250.7 kg/ha and 260.86 kg /ha during the first and second year, respectively) and fruit yield (28,923 kg/ha and 29,386 kg/ha) were observed and this was significantly higher than treatment offseason grazing + coir pith mulching which was on par with offseason grazing + hand weeding. Soil organic matter (SOM) content was enhanced due to integration of off grazing treatments and organic mulches. Highest SOM was recorded in offseason grazing + sugarcane trash mulching followed by coir pith integration.

Table-3. Effect of goat grazing, mulching and chemical control on the yield of *S. Melongena* L. and soil organic matter.

Treatment Details	Dry matter production (kg/ha)		Fruit yield (Kg/ha)		Soil organic matter content (%)	
	2008-2009	2009-2010	2008-2009	2009-2010	2008-2009	2009-2010
Off season grazing + Un-weeded control	175.36	185.36	26,116	26,876	0.38	0.40
Off season grazing + Hand weeding	210.67	225.86	27,421	28.248	0.44	0.45
Off season grazing + Pendimethalin @1kg a.i./ha	190.29	206.27	26,712	27,128	0.37	0.40
Off season grazing + Sugarcane trash mulching	250.75	260.86	28,923	29,386	0.61	0.63
Off season grazing + Coir pith mulching	215.63	228.17	28,075	28,327	0.58	0.59
Off season fallow + Un-weeded control	160.83	175.23	24,708	25,009	0.30	0.27
Off season fallow + Hand weeding	190.23	201.19	26,176	27,601	0.36	0.33
Off season fallow + Pendimethalin @1kg a.i./ha	162.37	176.12	25,123	26,827	0.32	0.31
Off season fallow + Sugarcane trash mulching	198.67	213.32	27,008	28,118	0.50	0.51
Off season fallow + Coir pith mulching	190.23	201.78	26,216	27,018	0.47	0.49
Standard Error difference.	2.25	2.57	345	317	0.03	0.03
Critical Difference(P=0.05)	4.97	5.23	762	701	0.08	0.08

DISCUSSION

Goat grazing repeatedly in fields during off seasons before growing an eggplant crop may have depleted the food reserves and rejuvenation potential of underground propagules of perennial weeds such as *C. dactylon* and this could have helped reducing their

population to minimum during cropping season that followed. This has been shown previously by Kathiresan (2010). Accordingly contribution of goat grazing on the control of *T. portulacastrum* and *A. viridis* is comparatively less. As a supplement to fill up this gap, mulching with crop waste such as sugar cane trash performed superior by its weed smothering effect. As a wholistic integration goat grazing + sugar cane trash mulching was excelling other conventional treatments like hand weeding or herbicides. Weed infestations are lesser in farmers holdings where in mulching is practiced using sugarcane trashes compared to those with coconut coir mulching. This is attributed to better smothering efficiency by virtue of higher magnitude of blocking sun light and aeration by continuous surfaces of trashes compared to smaller particles of coconut coir. Similar observation is reported earlier by Vijayabaskaran and Kathiresan (1993).

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