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Integrated Management of Purple Nutsedge (*Cyperus rotundus* L.) in Okra

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ABSTRACT

Maximum productivity of 5.24 t ha^{-1} was realised by stale seed bed with eucalyptus mulched plots which was 171.5 and 11% more than weedy check and weed-free plots, respectively. Stale seed bed with either polyethylene mulching or pre- and post-planting glyphosate application was identified as the effective nutsedge control measure. The most economical treatment was stale seed bed with glyphosate application integrated with eucalyptus mulching and it recorded the highest net return (Rs.18,270) and B : C ratio (2.01).

INTRODUCTION

Purple nutsedge (*Cyperus rotundus* L.), a native of India, is a pernicious perennial weed in 52 crops in more than 90 tropical and sub-tropical countries (Bendixen and Nandihalli, 1987) and is ranked as one of world's worst weeds (Holm *et al.*, 1977). It is propagated mainly by tubers, which have several buds that can sprout repeatedly which make cultural or manual methods ineffective. The longevity of tubers, the ability of tubers to sprout several times, and the lack of herbicides that can kill dormant tubers have made purple nutsedge control difficult. Research workers from time to time have suggested various cultural, mechanical, chemical and biological control measures, yet this weed continues to infect vast productive land and still remains as the tropical scourge in cultivated crop. Knowledge of successful cultural practices needs to be expanded and used to supplement mechanical and chemical control practices. Past studies indicated that several cultural practices like smother cropping can shift the competitive advantage of nutsedge to crops. The lack of aggressiveness of nutsedges in crops that quickly form a shade canopy suggests that additional knowledge of crop management practices should be developed to take advantage of the sensitive nature of nutsedge to shade. In this backdrop, the present investigation was conducted to develop an economically viable integrated weed management strategy for nutsedge in a cropped field.

MATERIALS AND METHODS

The investigation was undertaken at Instructional Farm, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala during summer seasons of 2001 and 2002 in a nutsedge infested area. Soil of the experimental site belonged to the taxonomical class, loamy kaolinitic isohyperthermic rhodic haplustox and analysed low in available nitrogen, medium in available phosphorus and potassium with a pH 5.2. The experimental site was lying fallow and was completely infested with nutsedge. The field was ploughed, clods broken, stubbles removed and the field was laid out into plots of size 3 x 3 m in three replications and 11 treatments were laid out in randomised block design. Recommended package of practices was adopted to raise experimental crop. Treatments consisted of combinations of stale seed bed, glyphosate application, polythene mulching, eucalyptus leaf mulching, cowpea intercropping, soil exposure, hand weeding, weed-free and weedy (Table 1).

Stale seed beds were prepared by digging the field during the month of February to expose and break the nutsedge tuber chains. This was followed by irrigation to stimulate sprouting of dormant tubers. Glyphosate at 1.5 kg ha^{-1} as per treatment was sprayed after one month of growth as pre-plant spraying. Post-planting direct spraying

Table 1. Effect of treatments on nutsedge growth

Treatment	Density (No m^{-2})				Shoot dry weight ($g\ m^{-2}$)				Tuber dry weight ($g\ m^{-2}$)			
	Initial		Final		Initial		Final		Initial		Final	
	I year	II year	I year	II year	I year	II year	I year	II year	I year	II year	I year	II year
SSB+Gly+3 HW at I5, 30, 45 DAS	325	293	216	203	432.6	494.3	175.6	324.2	0644.0	0884.5	0323.2	0554.3
SSB+GIy+Polyethylene	381	293	120	050	346.6	424.1	160.5	131.8	0902.3	0912.5	0244.6	0251.4
SSB+Gly+Eucalyptus	316	270	149	193	392.3	477.7	216.3	295.5	1070.8	0830.8	0580.5	0448.1
SSB+Gly+Cowpea	346	313	245	233	374.4	479.4	237.0	388.1	0757.8	0828.8	0617.3	0685.3
SSB+Gly (pre-plant)+Gly (post-plant)	278	380	097	130	376.9	518.5	185.2	206.2	0697.5	1100.5	0234.1	0412.1
SE+3 HW at 15, 30, 45 DAS	281	343	197	193	356.1	322.0	229.1	185.1	0795.2	0872.2	0370.3	0506.6
SE+Polyethylene	354	300	101	083	438.1	334.9	194.0	96.7	0728.7	0753.6	0366.4	0255.5
SE+Eucalyptus	303	320	257	207	390.7	269.0	231.2	202.6	0936.0	0839.5	0715.5	0476.1
SE+Cowpea	318	313	187	247	500.1	298.7	157.8	229.1	0682.4	0814.0	0342.4	0629.0
Weedy	309	343	393	437	473.8	285.1	534.5	448.2	0698.4	0801.8	1722.4	1505.4
Weed-free	321	300	000	000	473.3	291.8	0000	0000	0838.9	0905.5	00000	00000
LSD (P=0.05)	NS	NS	5.95	7.46	028.8	015.0	NS	10.7	NS	NS	29.8	21.6

SSB–Stale seed bed, SE–Soil exposure, HW–Hand weeding, Gly–Glyphosate (1500 g ha^{-1}).
NS–Not Significant.

of glyphosate at 1.5 kg ha^{-1} was done between rows of okra one month after sowing. Black polythene sheets of 300 gauge thickness were used as the mulching material. For imposing this treatment, the land was thoroughly levelled and holes of 12 cm diameter were made on polythene sheet at 30 cm distance and the sheet was spread on the whole plot. Dry leaves of eucalyptus collected from college garden were used as the mulch material at 10 t ha^{-1}. Three rows of cowpea variety C-152 were raised in between two rows of okra at a spacing of 10 cm and were mulched at 25 days after sowing. In soil exposure plots, the land was dug well so as to bring the underground tubers to surface and they were exposed to sun for three days for desiccation. The okra variety Varsha Uphar was sown on ridges at a spacing of 60 x 30 cm.

RESULTS AND DISCUSSION

Effect on Nutsedge

Stale seed bed with polythene mulching or pre- and post-planting glyphosate application were the best in getting the highest level of control (Table 1) of nutsedge. By stale seed bed technique, the dormant underground tubers were stimulated to sprout and the sprouted shoots were killed by glyphosate spraying which reduced dormant tuber reserve on soil. The effectiveness of stale seed bed to achieve weed control in rice has been reported by John and Mathew (2001). Polyethylene mulching was very effective in suppressing nutsedge growth because of the higher temperature developed in soil under black polyethylene mulch by which many of the tubers have been made non-viable reducing further growth and regeneration. Yadav *et al.* (1996) reported that black polyethylene mulching after one hand weeding at 70 DAS of crop provided more than 98% control of *C. rotundus*, while hand weeding could provide only 60% control of this weed.

Post-planting glyphosate application after stale seed bed recorded the highest percentage reduction of nutsedge population (Table 1). The effectiveness of glyphosate at 1.5 kg ha^{-1} in controlling nutsedge without regeneration for a period of six weeks has been reported earlier by Ameena (1999). Stale seed bed with cowpea emerged as the least effective treatment in controlling nutsedge as it could not smother weed effectively as evident from the low WCE values. Treatment combinations involving polyethylene mulching were the best treatments in reducing weed dry matter production.

Effect on Crop

Stale seed bed coupled with mulchings registered maximum LAI during both the years, while mulchings alongwith soil exposure recorded significantly lower LAI. Stale seed bed coupled with eucalyptus mulching recorded maximum mean yield of 5.24 t ha^{-1} which was closely followed by soil exposure treatment combined with polyethylene mulching (5.21 t ha^{-1}). Greater dry matter production in these treatments was a cumulative effect of higher values of LAI and fruits per plant. Polyethylene was found the best mulching material compared to eucalyptus litter. Stale seed bed showed superiority over soil exposure treatments because it brought dormant tubers of nutsedge also under its area of control. This coupled with glyphosate spraying had an added advantage of better nutsedge control alongwith suppression by mulch on the regenerated shoots of nutsedge. According to Hosmani and Meti (1993) stale seed bed encouraged a flush of new weed seedling, which could be controlled very easily prior to planting. The smother crop of cowpea failed to smother nutsedge and instead smothered the crop in its initial stages (Table 2). Thus, expected advantage of raising cowpea crop was not realized. The yield loss was maximum under unweeded control plot, while SSB+eucalyptus mulching had the minimum loss followed by polyethylene mulching treatments.

Economics

Stale seed bed with glyphosate application integrated with eucalyptus mulching recorded the highest net return of Rs. 18,270 ha^{-1} and B : C ratio of

Table 2. Effect of treatments on okra

Treatment	LAI (mean)		Dry matter at harvest (t ha^{-1})	Fruits plant^{-1}	Fruit yield (t ha^{-1})			Economics (Rs. ha^{-1})			
	At flowering	At harvest	Pooled	Mean value	I year	II year	Pooled	Addl. cost for weed control	Gross income	Net income	B : C ratio
SSB+Gly+3 HW at I5, 30, 45 DAS	1.84	0.15	4.70	29	2.39	6.23	4.31	6710	30170	8460	1.38
SSB+GIy+Polyethylene	2.00	0.47	4.85	32	2.33	7.30	4.81	13410	33705	5295	1.19
SSB+Gly+Eucalyptus	2.09	0.54	7.99	30	4.95	5.53	5.24	3410	36680	18270	2.01
SSB+Gly+Cowpea	0.49	0.14	2.70	15	1.47	3.76	2.62	4110	19350	195	1.01
SSB+Gly (pre-plant)+ Gly (post-plant)	1.13	0.17	3.65	21	1.99	4.33	3.16	5070	22120	2050	1.10
SE+3 HW at I5, 30, 45 DAS	1.89	0.35	3.15	24	1.72	5.56	3.64	5250	25480	5230	1.25
SE+Polyethylene	1.80	0.33	5.25	31	4.35	6.06	5.21	11750	36435	9685	1.36
SE+Eucalyptus	1.79	0.43	5.51	21	3.31	4.16	3.74	1750	26145	9395	1.56
SE+Cowpea	0.58	0.14	4.68	14	3.14	3.90	3.52	2450	24640	7190	1.41
Weedy	0.20	0.14	2.47	12	1.42	2.43	1.93	0.0	13475	-1525	0.89
Weed-free	1.83	0.42	7.61	25	4.19	5.23	4.71	7000	32970	10970	1.50
LSD (P=0.05)	0.17	0.09	4.49	14.8	1.25	2.41	2.70	-	-	-	-

Cost of glyphosate	Rs. 480 l^{-1}	Cost of FYM	Rs. 295 t^{-1}
Cost of black polyethylene mulch	Rs.480 m^{-2}	Cost of urea	Rs. 3.5 kg^{-1}
Wage rate of ordinary labourer	Rs. 100 day^{-1}	Cost of mussoriephos	Rs. 4.0 kg^{-1}
Rent of sprayer	Rs. 4 h^{-1}	Cost of MOP	Rs. 5.0 kg^{-1}

2.01 and was found to be the most remunerative weed management practice (Table 2). Completely weed-free treatment registered a net return of Rs. 10,970 and was the next best treatment. On comparing the B : C ratio, it was evident that soil exposure treatments were more economical than stale seed bed except when stale seed bed was integrated with eucalyptus mulching. Soil exposure treatments fared well compared to stale seed bed treatments because of additional labour and input cost involved in stale seed bed than soil exposure. Polyethylene mulching under both the treatment combinations recorded good returns, however, the higher expenditure on weed control brought down the B : C ratio.

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