Indian Journal of Weed Science **52**(1): 69–73, 2020

Print ISSN 0253-8040 Online ISSN 0974-8164

Integrated weed management in elephant foot yam

J. Suresh Kumar*, S. Sunitha, J. Sreekumar M. Nedunchezhiyan[1], K. Mamatha[2], Biswajith Das[3], S. Sengupta[4], P.R. Kamalkumaran[5], Surajit Mitra[6], Jayanta Tarafdar[6], V. Damodaran[7], R.S. Singh[8], Ashish Narayan[7], Rabindra Prasad[8], Pradnya Gudadhe[9], Ravinder Singh[10], K. Desai[11] and B. Srikanth[12]

ICAR-Central Tuber Crops Research Institute, Thiruvananthapuram, 695 017, Kerala, India [1]ICAR-CTCRI, Regional Centre, Bhubaneswar, Odisha, 751 019, India; [2]Dr YSR Horticultural University, HRS, Kovvur, 534 350, West Godavai, Andhra Pradesh, India; [3]ICAR Research Complex for NEH Region, Tripura Centre, Lembucherra, 799 210, Tripura, India; [4]Birsa Agricultural University, Kanke, Ranchi, 834 006, Jharkand, India; [5]Horticultural College & Research Institute, Tamil Nadu Agril. University,Coimbatore, 641 003, Tamil Nadu, India; [6]Bidhan Chandra Krishi Viswavidyalaya, Nadia, Kalyani, 741 235, West Bengal, India; [7]Central Island Agricultural Research Institute, 181, Port Blair, 744 101, Andaman & Nicobar Islands, India; [8]Dr RPCAU, TCA, Muzaffarpur, Dholi-848 121, Bihar, India; [9]Central Experiment Station, Dr.B.S.KKV, Dapoli, Ratnagiri, Wakawalli, 415 711, Maharashtra, India; [10]CSKHPKV, Palampur, 176062, Himachal Pradesh, India; [11]Aspee College of Horticulture & Forestry, NAU, Navsari, 396 450, Gujarat, India; [12]ICAR- Indian Agricultural Statistics Research Institute, New Delhi, India

**Email: suresh.j@icar.gov.in*

Article information

DOI: 10.5958/0974-8164.2020.00012.X

Type of article: Research article

Received : 19 January 2020
Revised : 21 March 2020
Accepted : 24 March 2020

Key words
Elephant foot yam
Herbicide
Integrated weed management
Weed control efficiency

ABSTRACT

An experiment was conducted to find out the most effective method of weed management in elephant foot yam. The experiment was conducted under 10 different agro-climatic conditions of India including plains, hills and islands, etc. using RBD with 8 treatments and 3 replications, during 2017 and 2018. *Cyperus rotundus, Cynodon dactylon* and *Commelina benghalensis* were the predominant weeds at most of the locations. Among different treatments, hand weeding thrice at 30, 60, 90 days after planting (DAP) recorded taller plants (80.85 cm) with more pseudo stem girth, canopy spread (97.07 cm), leaf area (5435.37 cm^2), corm yield (38.0 t/ha), and net returns (₹ 387253), which was at par with weed control ground cover mat mulching and application of glyphosate thrice at 30, 60 and 90 DAP. Lower weed density and biomass were recorded in treatment with weed control ground cover mat mulching, which was at par with glyphosate applied at 30, 60 and 90 DAP.

INTRODUCTION

Elephant foot yam [*Amorphophallus paeoniifolius* (Dennst.) Nicolson] is a tuberous vegetable crop grown in tropical and subtropical regions, particularly in South-East Asia. The area and production of elephant foot yam in India is reported as 26,000 ha and 6.59 lakh metric tons, respectively (NHB 2017). In the present scenario of climate change, it has assumed more importance than before due to some un-parallel edges over other crops like producing optimal yields during adverse climatic conditions (Singh *et al*. 2018). Its farming is eco-friendly because of lesser use of agrochemicals. The underground stem tuber (corm) is used in the preparation of various cuisines and has been reported to have medicinal properties (Dey *et al*. 2010). Elephant foot yam is a highly nutritive vegetable (Gopalan *et al*. 1999). Weeds are potentially major constraints in producing higher yield and quality produce in tuber crops as they compete with the roots for applied resources and sometimes weed roots penetrate into the underground storage organs of tuber crops and reduce the quality of produce (Suresh *et al.* 2019). Elephant foot yam is susceptible to weed growth especially during initial growth phases due to the time gap between planting and sprouting, and slower canopy spread in first few months (Ravindran *et al*. 2010). Weed infestation at the early stage of crop development causes severe yield reduction upto 100% in wide-spaced plantings (Nedunchezhiyan *et al*. 2018). Weeds compete for all available resources both below (water, nutrients, space) and above ground (space, light) and thereby reduce the crop growth and yield. Weeds are

alternative hosts to many pests and disease causing organisms. Weeding alone requires more than 30% of the total labour in this crop and it is approximately 150-200 mandays/ha (Nedunchezhiyan *et al*. 2018). Manual weeding is expensive, tedious and time consuming where the labour is scarce or where farm size is large. Application of herbicides for weed control as pre- or post-emergence can reduce dependency on manual weeding and reduce cost of production. The present study was undertaken at different locations of India by centres under the All India Coordinated Research Project on Tuber Crops to find out the most effective integrated weed management (IWM) option in elephant foot yam.

MATERIALS AND METHODS

Field experiments were conducted during 2017 and 2018 at 10 locations representing different agro-climatic conditions of India by centres under the All India Coordinated Research Project on Tuber Crops. The locations included hilly state of Himachal Pradesh at CSKPHKV, Palampur (Western Himalayan zone); Island of Andaman & Nicobar at ICAR-CIARI (Islands zone); Eastern plains at BCKV, Kalyani, West Bengal (Lower Gangetic plains zone) and Dr RPCAU, Dholi, Bihar (Middile Gangetic plains zone); North Eastern plains at ICAR-RC, Lembucherra, Tripura (Eastern Himalayan zone); East Coast plains at Dr YSRHU, Kovvur, Andhra Pradesh (East Coast plains and hills zone); North West at NAU, Navsari, Gujarat (Gujarat plains and hills zone); Southern part at TNAU, Coimbatore, Tamil Nadu (Southern plateau and hills zone); West Coast at Dr BSKKV, Dapoli, Maharashtra (West Coast plains and hills zone); Central part of India at BAU, Ranchi, Jharkhand (Eastern plateau and hills zone). The experiment was laid out in a randomized block design with three replications and eight treatments, *viz*. pendimethalin 1000 g/ha (PE) + glyphosate 860 g/ha (PoE) at 45 and 90 DAP, pendimethalin 1000 g/ha (PE) + hand weeding 45 and 90 DAP, raising green manure cow pea in interspaces along with planting and incorporation 45-60 DAP + glyphosate 860 g/ha (PoE) at 90 DAP, hand weeding 45 DAP + glyphosate 860 g/ha (PoE) at 90 DAP, glyphosate 860 g/ha (PoE) at 30, 60 and 90 DAP, weed control ground cover mat (120 gsm) mulching, hand weeding at 30, 60 and 90 DAP, control (no weeding). The size of plots was 4.5 x 4.5 m, spacing followed was 90 x 90 cm to accommodate 25 plants in each plot. All other agronomic practices were followed according to the package of practices recommendations (Mohan *et al*. 2000). Healthy cut corm pieces with central bud intact of elephant foot yam cv. '*Gajendra*', weighing 500 g, treated with cow dung slurry (10 kg of fresh cow dung dissolved in 10 L of water and mixed with 50 g of fungicide) one day before. The pre-emergence herbicide pendimethalin was applied one day after planting corms; care was taken for maintaining minimal soil moisture while applying the herbicide for its best results. The post-emergence herbicide glyphosate was applied directly on weeds as per treatments. Herbicides were applied without drift on elephant foot yam plants with a manually operated knapsack sprayer with a flat-fan nozzle attached to a hood using a spray volume of 500 litres/ha. Weed control ground cover mat mulching (120 GSM) done immediately after planting, proper care has taken to allow the growing shoot of corm to penetrate without any hurdles by ground cover mat mulching. Uniform need based plant protection measures were also taken up to control the pests and diseases.

From each net plot five plants were marked randomly as the representative sample for recording observations. Plant height, pseudo stem girth and canopy spread were recorded from the selected five plants at 3 and 5 MAP (months after planting). Leaf area was estimated according to Ravi *et al.* (2010). Weed data collected on parameters such as occurring weed species, weeds density and biomass, weed index (WI) and weed control efficiency (WCE). The weed index (WI) defined as "the reduction in yield due to the presence of weeds in comparison with no weed plot" was worked out for each plot with the formula suggested by Gill and Kumar (1996) and expressed in percentage. WI= [(X-Y)/X] * 100

Where, X= Yield from weed free plot; Y= Yield from the treated plot.

The weed control efficiency (WCE) was calculated by the following formula suggested by Patil and Patil (1993) and expressed in percentage. WCE= [(DMC-DMT)/DMC]*100

Where, DMC= dry matter of weed in control plot; DMT= dry matter of weed in treatment plot.

Corm yield, gross returns, cost of cultivation, net returns and B:C ratio were calculated after the crop harvest. Data on weeds and plant parameters over the locations were pooled and analysed in SAS statistical software (Version 9.4, SAS Institute, Inc., Cary, NC, USA). Analysis of variance (ANOVA) was carried out appropriate to the design of experiment. Treatment means were compared using least significant difference (LSD) at 5% probabilities.

RESULTS AND DISCUSSION

The analysis of variance for experimental design (**Table 1**) revealed highly significant mean squares differences due to treatments, locations and their

interactions for all the characters studied. This indicates existence of diversity with treatments and locations.

Table 1. Effect of "Location", "Treatment" and their interaction on different characters in elephant foot yam under integrated weed management

Factors		Location	Treatment	Location* Treatment	Error	Total
Degrees of freedom		9	7	63	158	239
Weed density	F	1181.8	469.1	61.0		
	P	***	***	***		
Dry weight of weeds	F	184.9	107.7	27.6		
	P	***	***	***		
Plant height at 3MAP	F	77.0	18.5	5.1		
	P	***	***	***		
Plant height at 5MAP	F	123.3	30.0	5.7		
	P	***	***	***		
Pseudo stem girth at 3MAP	F	74.2	25.6	3.0		
	P	***	***	***		
Pseudo stem girth at 5MAP	F	118.7	26.5	3.1		
	P	***	***	***		
Canopy spread at 3MAP	F	239.0	30.0	5.4		
	P	***	***	***		
Canopy spread at 5MAP	F	143.5	63.9	10.4		
	P	***	***	***		
Leaf area at 3MAP	F	439.0	29.6	4.4		
	P	***	***	***		
Leaf area at 5MAP	F	1003.3	71.5	14.7		
	P	***	***	***		
Corm yield / plant	F	98.7	91.2	7.0		
	P	***	***	***		
Corm Yield/ ha	F	381.6	102.1	9.2		
	P	***	***	***		
Gross returns/ha	F	516.3	87.0	5.1		
	P	***	***	***		
Net return/ha	F	281.2	65.3	4.7		
	P	***	***	***		
B:C ratio	F	357.2	62.4	5.8		
	P	***	***	***		

F-values and statistical significance levels; * P < 0.05; NS: non-significant; ** P < 0.01; NS: non-significant; *** P < 0.001; NS: non-significant

Weed flora

The major weed species observed (**Table 2**) in the elephant foot yam field were: one sedge - *Cyperus rotundus* L.; Eleven grasses- *Brachiaria reptans* (L.); *Chloris barbata* Sw.; *Cynodon dactylon* L., *Digitaria sanguinalis* L., *Dinebra arabica* (syn of *D. retrofexa*) Jacq., *Echinochloa crusgalli* (L.) Beauv., *Echinocloa colona*, *Eleusine indica* (L.) Gaertn., *Paspalum scrobiculatum* L., *Setaria glauca* (L.) Beauv., *and Sorghum halepense* (L.) Pers.; Twenty one broad-leaved weed species – *Ageratum conyzoides* L., *Alternanthera paronichyoides, Amaranthus spinosus* L., *Calopogonium mucunoides* L., *Cannabis sativa* L., *Cleome viscosa* L., *Commelina benghalensis* L., *Digera arvensis* L., *Digera muricata* (L.) Mart., *Euphorbia hirta* L., *Euphorbia prostata*, *Merremia tridentate* (L.) Hallier f., *Mimosa pudica* L., *Parthenium hysterophorus* L., *Phyllanthus niruri* Hook. f., *Solanum nigrum* L., *Trianthema portulacastrum* L., *Tridax procumbens* L., *Vernonia cinerea* (L.) and *Xanthium strumarium* L. Among all the mentioned species, *Cyperus rotundus, Cynodon dactylon* and *Commelina benghalensis* were the dominant specie in most of the locations studied.

Weed density, weed biomass and weed control efficiency

Lower weed density and biomass were recorded with weed control ground cover mat mulching, which reduced total weed biomass, owing to complete cover of the ground which did not allow weeds to germinate and emerge. It was at par with glyphosate applied at 30, 60 and 90 DAP. The total weeds biomass is directly related to weed control

Table 2. List of observed weed species in experimental plots of elephant foot yam at different locations in India

Weed species observed in the experimental plots	Location
Amaranthus spinosus, Brachiaria reptans, Chloris barbata, Cynodon dactylon, Cyperus rotundus, Euphorbia hirta, Euphorbia prostrata, Parthenium hysterophorus, Trianthema portulacastrum,	TNAU, Coimbatore
Cynodon dactylon, Cyperus rotundus, Parthenium hysterophorus, Cleome viscosa, Tridax procumbens, Chloris barbata, Phyllanthus niruri, Vernonia cinerea	Dr. YSRHU, Kovvur
Amaranthus spp., *Cannabis sativa, Cleome viscose, Cynodon dactylon, Cyperus rotundus, Digera arvensis, Euphorbia sp., Leucas aspera, Parthenium hysterophorus, Physalis minima, Sorghum halepense*	RPCAU, Dholi
Alternanthera paronychioides, *Amaranthus spinosus*, *Brachiaria reptans,*	BSKKV, Dapoli
Cynodon dactylon, *Cyperus rotundus*, *Digitaria* sp., *Echinochloa* sp., *Vernonia cinerea*	
Cynodon dactylon, *Cyperus rotundus*, *Solanum nigrum*, *Mimosa pudica*, *Ageratum conyzoides*, *Euphorbia hirta*, *Xanthium strumarium*	BCKV, Kalyani
Celosia argentea, Commelina benghalensis, *Cynodon dactylon, Euphorbia, Setaria glauca, Cyperus rotundus, Digitaria sanguinalis, Eleusine indica*, *Echinochloa colona*	BAU, Ranchi
Abelmoschus moschatus, Alternanthera paronychioides, Digera muricata, Digera arvensis L., *Dinebra retroflexa, Echinochloa colona*, *Merremia tridentata, Phyllanthus fraternus, Physalis minima*, *Portulaca quadrifida*	NAU, Navsari
Ageratum conyzoides, *Amaranthus spinosus*, *Calopogonium mucunoides*, *Chloris barbata*, *Colocasia (wild)*, *Euphorbia hirta*, *Solanum nigrum*	CIARI, Port Blair
Commelina benghalensis, Cynodon dactylon, Cyperus rotundus, Digitaria sanguinalis, Echinochloa crus-galli, Paspalum sp.	CSK HPKV, Palampur
Ageratum sp., *Chloris* sp., *Cynodon* sp., *Cyperus rotundus* L., *Digitaria* sp., *Echinochloa* sp., *Eleusine* sp., *Galinsoga* sp., *Mimosa* sp., *Setaria* sp.	ICAR, RC, NEH, Lembucherra

efficiency (WCE). The WCE of different weed management treatments ranged 68.95-86.06% (**Table 3**). Higher WCE of 86.1% was achieved with weed control ground cover mat mulching and it was followed by 83.6% with raising green manure cow pea in interspaces along with planting and incorporation at 45-60 DAP followed by glyphosate application at 90 DAP because of their lower weed biomass. Significantly higher weed density and biomass were recorded in weedy check. Weed index (WI) was ranged from 1.55 to 48.73. Maximum weed index was recorded in the weedy check and the effective weed control treatment with lower weed index was weed control ground cover mat mulching. Better WCE with weed control ground covermat mulching in elephant foot yam was reported by Nedunzhiyan *et al*. (2013), George and Sindhu (2017), Nedunzhiyan *et al*. (2018); and in cassava (Nedunzhiyan *et al*. 2017).

Crop growth and yield attributes

The plant height, pseudo stem girth, canopy spread and leaf area were significantly ($p<0.05$) influenced by different weed control treatments (**Table 4**). All the treatments resulted in significantly taller plants than weedy check. Lesser weed infestation (weed biomass) in the treatments reduced competition for water, nutrients and space. It was aptly indicated by high WCE in the treatments (**Table 3**). At three months after planting treatment, glyphosate applied at 30, 60 and 90 DAP recorded taller plants with more pseudo stem girth, canopy spread and leaf area. The weed control ground cover mat mulching and hand weeding thrice at 30, 60 and 90 DAP were on par with it. In the initial stage, glyphosate, weed control ground cover mat mulching and hand weeding thrice effectively controlled the growth of the weeds and recorded similar results. At five months after planting, hand weeding thrice at 30, 60 and 90 DAP recorded taller plants with more pseudo stem girth, canopy spread and leaf area, and which was at par with treatment of glyphosate three sprays at 30, 60 and 90 DAP. Lower crop growth and yield attributes due to suppression of weeds led to lower yield (40.87 - 50.72% reduction) in weedy check in all the locations. This may be due to season

Table 3. Effect of different treatments on weed density, biomass and weed control efficiency in elephant foot yam (pooled analysis of 10 locations at 3 months after planting)

Treatment	Weed density (no/m^2)	Weed biomass (g/m^2)	Weed control efficiency (%)
Pendimethalin 1000 g/ha (PE) + glyphosate 860 g/ha (PoE) at 45 and 90 DAP	96.79^{c}	59.40^{c}	69.85
Pendimethalin 1000 g/ha (PE) + hand weeding 45 and 90 DAP	97.63^{c}	61.17^{c}	68.95
Raising green manure cow pea in interspaces along with planting and incorporation 45-60 DAP + glyphosate 860 g/ha (PoE) at 90 DAP	76.13^{b}	32.25^{a}	83.63
Hand weeding 45 DAP + glyphosate 860 g/ha (PoE) at 90 DAP	108.70^{d}	49.02^{bc}	75.12
Glyphosate 860 g/ha (PoE) at 30, 60 and 90 DAP	61.66^{a}	34.82^{ab}	82.33
Weed control ground cover mat (120 gsm)	58.91^{a}	27.46^{a}	86.06
Hand weeding at 30, 60 and 90 DAP	80.23^{b}	51.19^{c}	74.02
Control (no weeding)	264.20^{e}	197.02^{d}	0
LSD (p=0.05)	8.55	14.80	-

Mean values in each column with same alphabet in the superscript does not differ significantly, PE- pre-emergence, PoE- post-emergence, DAP- Days after planting

Table 4. Plant biometric parameters as affected by different integrated weed management treatments in elephant foot yam (pooled analysis of 10 locations)

Treatment	Plant height (cm)		Pseudo stem girth (cm)		Canopy spread (cm)		Leaf area (cm^2)	
	3 MAP	5 MAP	3 MAP	5 MAP	3 MAP	5 MAP	3MAP	5MAP
Pendimethalin 1000 g/ha (PE) + glyphosate 860 g/ha (PoE) at 45 and 90 DAP	58.3^{bc}	77.7^{abc}	13.2^{b}	17.2^{c}	69.6^{c}	90.4^{b}	3113.8^{bc}	51537^{b}
Pendimethalin 1000 g/ha (PE) + hand weeding 45 and 90 DAP	56.6^{cd}	74.9^{c}	13.3^{b}	16.9^{cd}	67.7^{cd}	83.8^{d}	3074.4^{bc}	4890.9^{c}
Raising green manure cow pea in interspaces along with planting and incorporation 45-60 DAP + glyphosate 860 g/ha (PoE) at 90 DAP	58.7^{abc}	77.2^{bc}	13.3^{b}	17.5^{bc}	69.3^{c}	87.1^{c}	3177.0^{bc}	4909.7^{c}
Hand weeding 45 DAP + glyphosate 860 g/ha (PoE) at 90 DAP	55.5^{d}	71.2^{d}	12.4^{c}	16.0^{d}	65.1^{d}	81.2^{d}	3062.8^{c}	4837.3^{c}
Glyphosate 860 g/ha (PoE) at 30, 60 and 90 DAP	60.6^{a}	79.3^{ab}	14.5^{a}	19.1^{a}	74.2^{a}	94.2^{a}	3431.8^{a}	5261.0^{ab}
Weed control ground cover mat (120 gsm)	59.2^{ab}	75.6^{c}	13.3^{b}	17.5^{bc}	70.1^{bc}	83.1^{d}	3243.8^{b}	4871.6^{c}
Hand weeding at 30, 60 and 90 DAP	60.1^{ab}	80.8^{a}	14.3^{a}	18.4^{ab}	72.7^{ab}	97.1^{a}	3461.6^{a}	5435.4^{a}
Control (no weeding)	50.0^{e}	60.8^{e}	10.5^{d}	13.1^{e}	56.1^{e}	69.0^{e}	2357.6^{d}	3424.2^{d}
LSD (p=0.05)	2.2	3.2	0.7	1.0	2.8	3.0	175.1	202.3

*Mean values in each column with same alphabet in the superscript does not differ significantly, MAP- Months after planting

Table 5. Yield and economics of elephant foot yam as affected by different integrated weed management treatments (pooled analysis of 10 locations)

Treatment	Corm yield/ plant (kg)	Corm yield (t/ha)	Weed index	Gross returns (x10^3 ₹/ha)	Net returns (x10^3 ₹/ha)	B:C ratio
Pendimethalin 1000 g/ha (PE) + glyphosate 860 g/ha (PoE) at 45 and 90 DAP	2.47^{b}	32.91^{cd}	14.74	546.05^{c}	316.86^{d}	1.90^{bc}
Pendimethalin 1000 g/ha (PE) + hand weeding 45 and 90 DAP	2.50^{b}	34.59^{b}	10.39	559.08^{c}	321.65^{d}	1.79^{c}
Raising green manure cow pea in interspaces along with planting and incorporation 45-60 DAP + glyphosate 860 g/ha (PoE) at 90 DAP	2.52^{b}	34.37^{bc}	10.96	568.50^{c}	335.38^{cd}	1.91^{b}
Hand weeding 45 DAP + glyphosate 860 g/ha (PoE) at 90 DAP	2.30^{c}	31.89^{d}	17.38	541.07^{c}	313.50^{d}	1.79^{c}
Glyphosate 860 g/ha (PoE) at 30, 60 and 90 DAP	2.57^{b}	34.65^{b}	10.23	603.90^{b}	377.15^{ab}	2.10^{a}
Weed control ground cover mat (120 gsm)	2.76^{a}	38.60^{a}	0.00	614.14^{ab}	356.41^{bc}	1.83^{bc}
Hand weeding at 30, 60 and 90 DAP	2.75^{a}	38.00^{a}	1.55	632.84^{a}	387.25^{a}	1.92^{b}
Control (no weeding)	1.36^{d}	19.79^{e}	48.73	325.47^{d}	122.33^{e}	1.03^{d}
LSD (p=0.05)	0.13	1.61	--	28.73	28.64	0.11

* Mean values in each column with same alphabet in the superscript does not differ significantly, LSD-least significant difference at the 5% level of significance, PE- pre emergence, POE- post emergence, DAP- Days after planting.

long crop-weed competition in weedy check plots, which was indicated by lower WCE, as well as lower crop growth and yield attributes (**Table 4** and **5**). Treatments with weed control ground cover recorded higher yields, which was at par with hand weeding thrice at 30, 60 and 90 DAP. Effective control of weeds and marked improvement in the crop growth and yield attributes led to higher corm yield in these treatments (**Table 5**).

Economics

Maximum cost of cultivation was incurred in weed control ground cover mat mulching due to its higher price per unit area (₹ 22/m^2). As the durability of soil covering ground cover mat is five years, if it is reused for more years can reduce expenditure on purchase of soil covering ground cover mat mulch. Higher gross and net returns were obtained with hand weeding thrice at 30, 60 and 90 DAP, which was closely followed by weed control ground cover mat mulching and three applications of glyphosate at 30, 60 and 90 DAP. Significantly higher B:C ratio was recorded by glyphosate applications at 30, 60 and 90 DAP due to less cost of cultivation as compared to higher price of weed control ground cover mat and higher human labour requirement and their wages in hand weeding.

It may be concluded that hand weeding is an effective and economical weed management option for managing weeds in elephant foot yam in India.Weed control ground cover mat mulch and post-emergence application of glyphosate may be advised as better alternative weed management options, where laborers are scarce and costly.

REFERENCES

Dey YN, Das SS, Sen M, De S, Ghosh and AK. 2010. Anti-inflammatory activity of methanolic extracts of *Amorphophallus paeniifolius* and its possible mechanism. *International Journal of Pharma and Bio Sciences* **1**(3): 1-8.

George TC and Sindhu PV. 2017. Weed management in elephant foot yam [*Amorphophallus paeoniifolius* (Dennst.) Nicholson]. *Journal of Tropical Agriculture* **55**(1): 76-80.

Gill HS and Kumar V. 1984.Weed index a new method for reporting weed control trial. *Indian Journal of Agronomy* **14**(1): 96-98.

Gopalan C, Sastri V, Balasubramanium SC, Rao BSN, Dosthale YG and Pant KC. 1999. *Nutritive value of Indian foods.* Indian Council of Medical Research Technological Bulletin. National Institute of Nutrition, Hyderabad, 50 p.

Mohan CR, Nair GM, George J, Ravindran CS and Ravi V. 2000. Production technology of tuber crops. *CTCRI Bulletin*. ICAR-Central Tuber Crops Research Institute, Thiruvananthapuram, Kerala, India, pp 15-20.

Nedunchezhiyan M, Byju G, Veena SS and Ravi V. 2017. Herbicides and polythene mulching effects on yield of cassava. *Indian Journal of Weed Science* **49**(1): 58-62.

Nedunchezhiyan M, Laxminarayana K and Chauhan VBS. 2018. Soil microbial activities and yield of elephant foot yam as influenced by weed management practices in alfisols. *International Journal of Vegetable Science* **24**(6): 583-596.

NHB (National Horticulture Board). 2017. *Horticultural Statistics at a Glance*. Government of India, 16 p.

Ravi V, George J, Ravindran CS, Suja G, Nedunchezhiyan M and Byju G. 2010. Method for leaf area determination in elephant foot yam [*Amorphophallus paeoniifolius* (Dennst.) Nicolson]. *Journal of Root Crops* **36**(1): 78-82.

Ravindran CS, Ravi V, Nedunchezhiyan M, George J and Naskar SK. 2010. Weed management in tropical tuber crops: An overview. *Journal of Root Crops* **36**(2): 119-131.

SAS. 2010. SAS Institute Inc. Cary, NC, USA.

Singh RS, Ashish N and Singh PP. 2018. Effect of weed management practices on weed dynamics yield and economics of elephant foot yam (*Amorphophallus paeoniifolious*). *International Journal of Current Microbiology and Applied Sciences* **7**: 4592-4598.

Suresh Kumar J, Sanket J. More, Byju G, Sunitha S, Veena SS, Nedunchezhiyan M and Ravi V. 2019. Effect of new generation herbicides on weed management, corm yield and economics of elephant foot yam [*Amorphophallus paeoniifolius* (Dennst.) Nicolson].*International Journal of Chemical Studies* **7**(3): 1213-1218.