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Effect of weed management practices on weed dynamics, growth and yield of taro (*Colocasia esculenta* (L.)

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Abstract
An experiment was conducted to find out most suitable weed management practices for weed management in taro during the year 2021-22 to 2022-23 at Agricultural Research Farm, Dholi of Tirhut College of Agriculture under Dr. Rajendra Prasad Central Agricultural University, Pusa (Bihar) in sandy loam soil in randomized block design having eight treatments [T_1-Application of quizalofop ethyl @ 75 g a.i./ha at 25 DAP + Application of glyphosate 41 SL @ 1000 g a.i/ha at 45 & 90 DAP; T_2-Application of quizalofop ethyl @ 75 g a.i./ha at 25 DAP + Hand weeding at 45 and 90 DAP; T_3- Hand weeding at 30 DAP+ Application of glyphosate 41 SL @ 1000 g a.i/ha at 60 and 90 DAP; T_4- Sowing cow pea in interspaces and incorporation at 45 DAP + Application of glyphosate 41 SL @ 1000 g a.i/ha at 90 DAP; T_5- Mulching with black polythene sheet; T_6- Straw mulching in interspaces; T_7- Complete weed free (hand weeding at 30, 60 and 90 DAP); T_8- T_8: Control (weedy plot)] with three replications. It was found that found that significantly lowest weed population (8.73/ m^2) and weed dry weight (2.38 g/ m^2) was recorded in T_5 than weedy plot and found at par with other weed management practices and the extent of reduction was to the tune of 82.02 to 94.82 and 92.94 to 98.09 percent, respectively with respect to weedy plot. Plant height, number of green leaves/plant, number of tillers/plant recorded in T_7 was significantly higher than weedy plot and the increase were to the tune of 42.96 to 60.19, 26.62 to 46.54 and 42.32 to 60.75 percent, respectively. Similar trend was also noticed for corm and cormel yield/plant, number co cormels/plant and corm and cormel yield on hectare basis. The extent of increase in cormel yield was to the tune of 54.22 to 81.12 percent respectively with respect to weedy plot which may be may be due to the effective weed control of weeds from the field during the crop period that kept almost weed free situation, provided environment of least competition for growth factors to taro plants and loosening of soil by hand weeding thrice favoured aeration in the root zone and congenial condition for cormel bulking of taro. In fact, yield of cormel is the cumulative effect of growth factors and yield attributes that ultimately reflected in yield realization.

Keywords: Colocasia/Taro, weed management, weed dynamics, growth, yield

Introduction
Taro (*Colocasia esculenta* (L.) is one of the most important tuber crops of India as well as of the world. It is also an important tuber crop grown in Bihar particularly in the districts of northern Bihar. In the present scenario of changing climate, it has assumed more importance than before due to some unparalleled edges over other crops like- its capacity to produce even in adverse climatic conditions without affecting much on its productivity and its high yield potential. Its farming is also eco-friendly because of less use of agro-chemicals (Singh *et al*., 2019). Taro (*Colocasia esculenta* (L.) is a stem tuber crop that belonging to Araceae family. It is also known as 'Elephant ear'. Its leaves are highly nutritious having good amount of protein and vitamins. The tuber of taro is rich source of starch (up to 21% of total carbohydrates), protein (above 3%) and minerals i.e. 3.9% (Gopalan *et al*., 1977) [6]. In India, taro is mainly grown for human consumption as cooked food. In India, the major colocasia growing states are Manipur, Assam, Nagaland, Orissa, Meghalaya, Gujarat, Maharashtra, Kerala, Andhra Pradesh, Tamil Nadu, West Bengal, Chhattisgarh, Uttar Pradesh, Jharkhand and Bihar. Taro is gaining popularity due to easiness in cultivation, good productivity, less incidence of pests and diseases and less use of pesticides, steady demand and reasonably good price due to its arrival in the market when most of the vegetable crops are damaged because of rain.

The yield potential of taro is seriously affected by weeds mainly for the competition of nutrients, water, light, air and space owing to the slow initial growth of this crop. Hand weeding by hired labourers is generally done by the farmers but due to scarcity and unavailability of labourers during peak period, increasing labour wages, time consuming and

cumbersome operation, it becomes imperative to go for chemical weed control due to its edge over manual weeding to overcome these problems (Singh *et al*., 2014) [9]. Weeds also harbour insect-pests and diseases. Weeds seriously affected the crop growth and cause heavy loss of taro yield. Therefore, weed management is necessary especially during initial period of about two months of crop growth. Keeping these facts in mind, this experiment was undertaken.

Materials and Methods

The experiment was conducted at Agricultural Research Farm, Dholi of Tirhut College of Agriculture under Dr. Rajendra Prasad Central Agricultural University, Pusa (Bihar) during the period of 2021-22 to 2022-23. The soil of the experimental plot was sandy loam with pH value of 8.1. Initial soil analysis value of experimental field was: available nitrogen (182.4 kg/ha), phosphorus (18.72 kg/ha), and potassium (141.2 kg/ha). There were eight treatments i.e., T_1- Application of quizalofop ethyl @ 75 g a.i./ha at 25 DAP + Application of glyphosate 41 SL @ 1000 g a.i/ha at 45 & 90 DAP; T_2-Application of quizalofop ethyl @ 75 g a.i./ha at 25 DAP + Hand weeding at 45 and 90 DAP; T_3- Hand weeding at 30 DAP+ Application of glyphosate 41 SL @ 1000 g a.i/ha at 60 and 90 DAP; T_4- Sowing cow pea in interspaces and incorporation at 45 DAP + Application of glyphosate 41 SL @ 1000 g a.i/ha at 90 DAP; T_5- Mulching with black polythene sheet; T_6- Straw mulching in interspaces; T_7- Complete weed free (hand weeding at 30, 60 and 90 DAP); T_8- T_8: Control (weedy plot).'Rajendra Arvi-1' was taken as test variety. Tubers of about 20-30 g size was planted at a spacing of 50 cm x 30 cm. Recommended dose of manures and fertilizers i.e., 15.0 t/ha of compost/FYM with 80: 60: 80 kg N: P_2O_5: K_2O /ha were applied uniformly in all the treatments.

The experiment was laid out in randomized block design with three replications. Weed samples were taken randomly at 20, 50 and 100 days after planting from three places using a quadrate of 0.25 m^2 and converted into weed population/ m^2. Thereafter weeds were oven dried and recorded as weed dry weight/m^2. Most dominating weed of the field was *Sorghum halepanse*. Other important weeds found were- *Cynodon dactylon, Cyperus rotundus, Digera arvensis, Physallis minima, Cannabis sativa, Euphorbia* spp, *Parthenium hysterophorus, Amaranthes* spp., *Cleome viscosa, Leucas aspera etc*. Tubers/corms were harvested from net area of 9.0 m^2 and converted into t/ha. Recorded data were analyzed following standard statistical procedures.

Results and Discussion

Different treatments of weed management practices with/without herbicides including control treatment produced significant effect on weed population, weed dry weight, growth characters as well as yield attributes and yield of taro (Table. 1 & Fig. 1).

Weed population/m^2 recorded at 100 DAP under different weed management practices were significantly influenced and it was significantly lowest under T_5 where mulching was done with black polyethene as compared to other weed management practices except $T_3$where hand weeding was done at 30 DAP followed by two sprays of glyphosate 41 SL @ 1000 g a.i/ha at 60 and 90 DAP may be due to obstructing photosynthetically active light reaching the ground surface. Lowest number of weeds under black polythene mulch may be due to high temperature and reduced light availability, reduced germination of light responsive seeds and physically blocking the emergence of most weeds. Black polyethylene absorbed all the incident radiations itself so there was less light penetration underneath the black polyethene which ultimately might have checked the weed seed germination and growth as compared to mulching by straw and other weed management practices. Similar finding were also reported by Ngouajio and Ernest, 2004 [8], Bakht *et al*. 2014 [2], Edgar 2017 [5] and Nedunchezhiyan *et al*. 2017 [7]). Significantly highest weed population per unit area was recorded in control plot than all other treatments. Other weed management treatments like T_1, T_2, T_4, T_6 and T_7 were found at par among themselves and recorded significantly lower weed population per unit area than weedy plot.

Weed dry weight/m^2 recorded at 100 DAP followed almost similar trend to that of weed population with significantly lowest value (2.38g) in T_5 which was found at par with all other treatments of weed management practices than T_4 and T_8. Significant highest weed population and dry weight of weeds recorded in weedy check since no weed management practices was done there. Maximum weed control efficiency was seen in treatment T_5 where mulching was done with black polyethene which was found at par with all other treatments except T_4 may be the reasons explained above for weed population. Similar results were presented by Nedunchezhiyan *et al*. 2017 [7] in cassava and Dulal Sarkar *et al*. 2019 [4] in onion. Reduction in weed population at 100 days after planting ranged from 82.02 to 94.82 percent and to that of weed dry weights and weed control efficiencies varied between 92.94 to 98.09 percent due to different weed management practices.

Plant height of taro recorded at 4 MAP was found significantly highest (52.35 cm) in T_7 than T_8 (weedy plot) but was found at par with all other treatments of weed management practices may be due to least competition for nutrients, soil moisture, light and space were offered by weeds as well as because of well aeration to plant roots by thrice hand weeding at 30,60 and 90 days after planting and in turn, availability of enough growth promoting factors. Significantly lowest plant height of taro was recorded in weedy plot because of severe competition for above and below ground growth factors offered by weeds. The increase in plant height due to different weed management practices was to the tune of 42.96 to 60.19 percent with respect to plant height of taro in weedy plot. These findings are in agreement with the findings of Akter *et al*.2013 [1].

Number of green leaves/plant and number of tillers/plant of taro recorded at four months after planting (4 MAP) were also significantly affected by different treatments of weed management practices and all the treatments showed superiority over weedy plot with the highest value of green leaves/plant (6.99) and number of tillers/plant (4.71) in T_7 where thrice hand weeding was done may be due to favourable growth promoting environment because of least competition offered by weeds for nutrients, soil moisture, light, air and space. Significantly lowest value of green leaves/plant (4.77) and number of tillers/plant (2.93) of taro was recorded in weedy plot may be due to unavailability of optimum space for better light interception, reduced nutrients, and moisture availability for the crop due to the presence of

weeds. Similar report was presented by Dalga *et al*. 2014 [3]. Number of cormels/plant and cormel weight/plant of taro was significantly influenced by different weed management practices which were found in all the treatments of different weed management practices over weedy plot with the highest value of 14.63 for number of cormels/plant and 418.67g for cormel weight/plant in T_7may be due to well aeration to plant roots, loosening of soil for better tuberization by thrice hand weeding at 30,60 and 90 days after planting and in turn, availability of enough growth promoting factors as also reported by Singh *et al*. 2016 [10]. Significantly lowest number of cormels/plant (9.40) and cormel weight/plant (214.50 g) of taro was recorded in weedy plot may be due severe competition of taro plants for nutrients, light, soil moisture, space and air with unchecked weeds.

Cormel yield of taro worked out on hectare basis was significantly influenced by different weed management practices which was found highest under T_7 where hand weeding was done thrice at 30,60 and 90 days after planting but it was found at par with T_2, T_4, T_5 and T_6 may be due to the effective weed control of weeds from the field during the crop period that kept almost weed free situation, provided environment of least competition for growth factors to taro plants and loosening of soil by hand weeding thrice favoured aeration in the root zone and congenial condition for cormel bulking of taro. In fact, yield of cormel is the cumulative effect of growth factors and yield attributes that ultimately reflected in yield realization. Yield increase of taro cormel was to the tune of 54.22 to 81.12 percent over weedy plot.

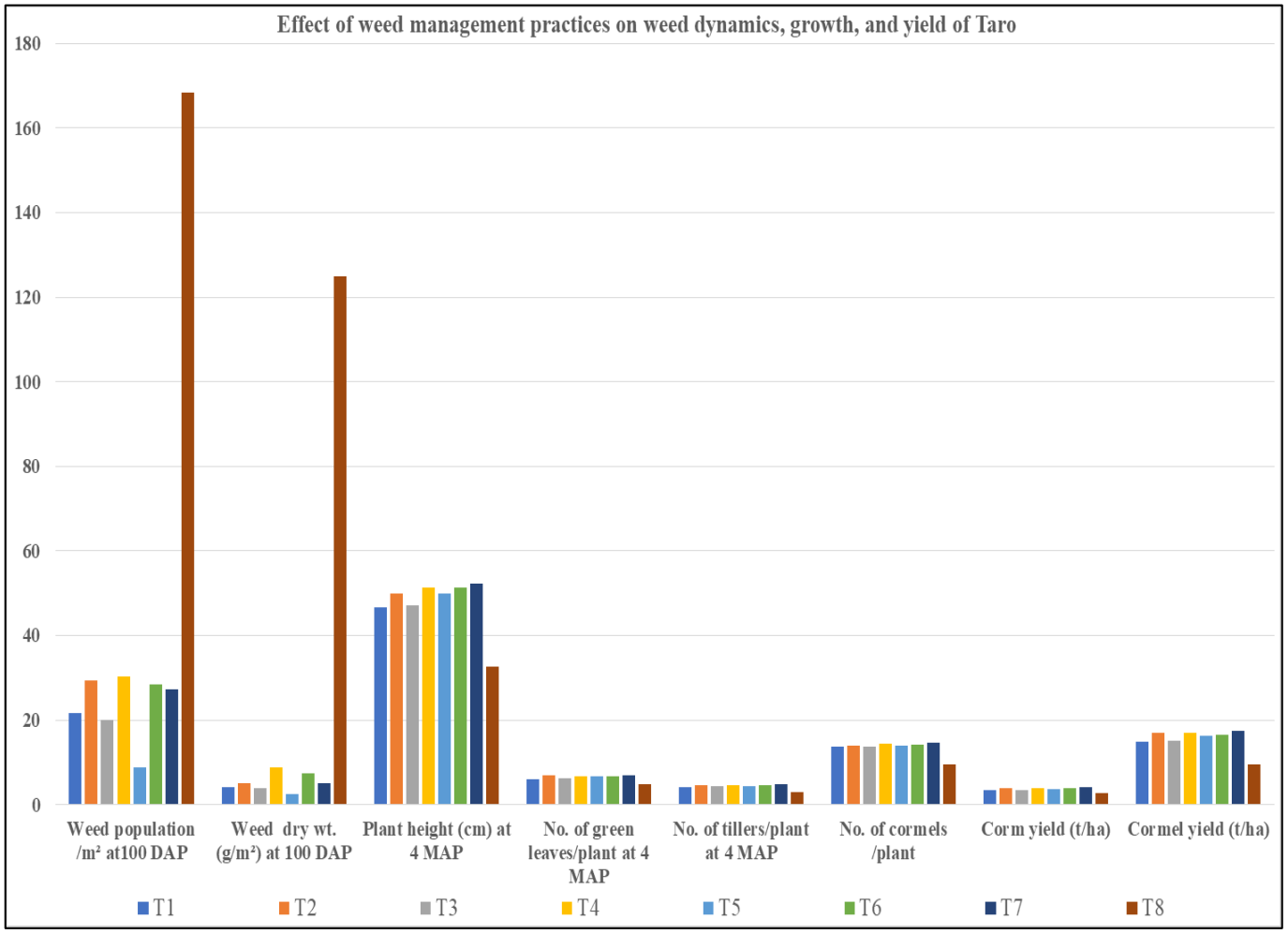

Fig 1: Effect of integrated weed management practices on weed dynamics, growth and yield of taro

Significantly lowest cormel yield of taro was recorded in weedy plot may be due severe competition of taro plants for nutrients, light, soil moisture, space and air with unchecked weeds that reflected in reduction of growth as well as yield characters and in turn, realization of lowest cormel yield. Similar findings were also observed by Singh *et al*., 2016 [10] in sweet potato, Singh *et al*., 2018 [11] in elephant foot yam, and Nedunchezhiyan *et al*. 2017 [7] in cassava.

Based on the findings of this experiment it can be concluded that weed management by hand weeding thrice is best for good for cormel yield of taro.

Table 1: Effect of integrated weed management practices on weed dynamics, growth and yield of taro

Treatments	Weed population/m² at 100 DAP	Weed dry wt. (g/m²) at 100 DAP	WCE (%) at 100 DAP	Plant height (cm) at 4 MAP	No. of green leaves/plant at 4 MAP	No. of tillers/plant at 4 MAP	No. of cormels/plant	Corm yield/plant (g)	Cormel yield/plant (g)	Corm yield (t/ha)	Cormel yield (t/ha)
T_1	21.66	4.18	96.65	46.72	6.04	4.17	13.67	161.50	362.67	3.48	14.79
T_2	29.27	5.13	95.89	49.82	6.83	4.50	13.95	173.83	404.67	3.80	16.85
T_3	19.92	3.94	96.85	47.07	6.21	4.28	13.78	167.00	371.67	3.52	15.14
T_4	30.28	8.82	92.94	51.32	6.71	4.52	14.35	179.50	408.50	3.88	17.00
T_5	8.73	2.38	98.09	50.03	6.62	4.41	13.92	171.33	402.00	3.63	16.33
T_6	28.39	7.37	94.10	51.35	6.76	4.58	14.21	176.83	404.17	3.82	16.41
T_7	27.36	5.02	95.98	52.35	6.99	4.71	14.63	186.50	418.67	4.05	17.37
T_8	168.43	124.93	0.00	32.68	4.77	2.93	9.40	115.50	214.50	2.72	9.59
CD (p=0.05)	12.19	6.14		8.64	0.89	0.21	1.67	37.24	63.50	0.54	1.88
S.Em (±_)	3.98	2.01		2.82	0.29	0.07	0.54	12.16	20.73	0.18	0.61
CV (%)	16.51	17.18		10.25	7.88	2.80	6.99	12.65	9.62	8.47	6.89

*DAP- Days after planting; MAP- Months after planting; WCE- Weed control efficiency

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