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Effect of weed management practices on weed control, yield, and economics in Rabi groundnut (*Arachis hypogaea* L.) in Ganjam district of Odisha

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Abstract
A field experiment was conducted in farmer's field through front line demonstrations during the rabi season of 2018 & 2019 in villages of Ganjam district i.e. Rajanapalli, Bananayee, Sunathara, Padmabati in Odisha on farmers field with the active participation of farmers with an objective to evaluate the effect of weed management practices on weed control, yield and economics of Rabi Groundnut (*Arachis hypogaea* L.) by KVK, Ganjam-II. Application of Oxyfluorfen 23.5 EC @ 0.2kg ha-1 at 2 DAS fb Imazethapyr 10 percent SL @ 100 g ha-1 at 15 DAS recorded higher pod yield (22.7/ha), maximum weed control efficiency (80.92, 76.39 and 75.10% at 20, 40 and 60 DAS respectively) and with maximum net return (71309 Rs/ha) and BCR (2.79) which were higher than farmers practices of one hoeing at 21 DAS. The demonstrated practice was proved practically more convenient and economically best feasible weed management practice for groundnut considering the present condition of scarcity and high cost of labours, quality of weed control, yield and B:C ratio of cultivation of rabi Groundnut.

Keywords: Groundnut, Weed control, Weed control efficiency, yield, Economic

Introduction
Groundnut (*Arachis hypogaea* L.) is an important oil seed crop of India which is cultivated in India during Rabi nearly 6.41million ha. Area with the production of 9.18 million tonnes and average productivity of 1.43 tonnes/ha (Srinivasarao *et al.*, 2011) [14]. In Odisha, Groundnut is grown in three seasons i.e. kharif (34% of total area i.e. 0.84 lakh ha), rabi and summer season (66% of total area i.e. 75 lakh ha) the production of 0.463million tones (Odisha Agricultural Statistics 2014-15) [1]. Groundnut (*Arachis hypogaea* L.) adorned as king of oilseeds, is one of the most important and ancient edible oilseed crop grown in India. India and China are the world's largest producers of groundnuts, accounting for over 41 percent and over 18 percent of world production, respectively. The yield of groundnut crop depends upon various agronomic management practices and there are several reasons for low productivity. One of the major factors responsible for low productivity of groundnut is weed infestation. Weed interference resulted in yield loss ranging from 74 to 92% (Agostinho *et al.*, 2006) [2]. Critical period of crop-weed competition for groundnut crop was reported to be up to 45 DAS and weed free environment during this period registered higher pod yield (Rao 2000) [11]. Due to slow growth of crop in the initial stages, weeds compete with the crop dominantly. The critical period for crop-weed competition was reported to be up to 45 days after sowing and yield losses up to 70 percent was recorded in groundnut due to weed infestation (Prasad *et al.*, 2002) [9]. Weed infestation is an important limiting factor in achieving potential productivity of groundnut (*Arachis hypogaea* L.), especially in bunch type of varieties with poor competitive ability. Yield loss due to heavy weed infestation in groundnut ranged from 13-80% in India (Ghosh *et al.* 2000) [4]. Unlike other crops, weeds interfere with pegging, pod development and harvesting of groundnut during different stages of crop growth, besides competing for growth resources. Hand weeding or hoeing which is very effective but it is not only laborious and insufficient but also expensive i.e. most of times due to continuous rains, scarcity of labours during difficult after the initiation of reproductive stages of growth and it also hinders the pegging and pod development and effective and economic weed control on large scale is not possible through age old practice of manual and mechanical means weeding should be completed before the pegging stage in groundnut. In present situation manual weeding is costlier and increase the production cost.

To avoid such experience one should require the most effective weedicide under rain fed condition. Pre-emergence (PE) herbicides *viz.* pendimethalin (Patel *et al.*, 2013) [8] and

oxyfluorfen (Ramalingam *et al.*, 2013) [10] and post-emergence (POE) herbicides, *viz.* imazethapyr (Kalhapure 2013) [6] and quizal of op-ethyl (Samant *et al.*, 2014) [12] were found very effective in controlling weeds, higher crop yield and increased income in different parts of the country. Thus, there is need to evolve efficient and economical viable system for managing weeds. Chemical weed control is easier, time saving and economical as compared to hand weeding alone. Thus, herbicides are the only alternatives left under such circumstances of unavailability of labours, high cost of labours and unfavorable environment. Presently a wide variety of old and new generation herbicides are available and being recommended for usage. Use of pre- and post-emergence herbicides offers an alternative viable option for effective and timely control of weeds in groundnut. But, each herbicide has its own spectrum of weed control. The timing of herbicide application also has much concern on weed control efficiency. Among them pendimethalin, oxyfluorfen and imazethapyr were used to manage weeds in groundnut in this experiment Imazethapyr is the first herbicide registered in peanut to provide both post-emergence and residual control of many problem weeds (Grichar and Sestak 2000) [5]. Use of chemical herbicides in oilseeds is observed to be very effective in weed management and boosting the yield of groundnut. Therefore, an experiment was carried out to find out most effective and cheaper weed control methods for harnessing the yield of *Rabi* groundnut in terms of both quality and quantity. Computational stress of weeds exerts reduction in pod yield of groundnut to the extent of 17 to 84% (Sasikala *et al*., 2006) [13]. Hence, weeds are widely regarded as "Pests of paramount importance" and ranked as "Prime enemies in agriculture."

Materials and Methods

The study was conducted out through front line demonstration during kharif season of 2018 and 2019 by Krishi Vigyan Kendra, Ganjam-II in village Rajanapalli, Bananayee, Sunathara, Padmabati of Ganjam district in Odisha on farmers field with an objective to evaluate the herbicides for weed management in groundnut. The district of Ganjam lies in two agro climatic zones i.e. East & South Eastern coastal plain zone and North Eastern Ghat Zone of Odisha extending from 18013'N to 19010' North latitude to 8205' to 83023' East longitude. The Average Normal Rainfall of this district is 1276.2 mm and more than 75% of the precipitation is received over five months i.e. June- October. Agriculture is the primary occupation of inhabitants of this district. The maximum and minimum temperature of this district is 39 ºC and 18.9 ºC respectively. The soil of the study area was sandy loam in texture with slightly acidic in reaction (pH-5.1 -5.5), low in organic carbon content (0.39-0.42%), low in available nitrogen (146.6-163.8 kg ha-1), low in phosphorus (6.85-11.6 kg ha-1) and medium in potassium (178-208 kg ha-1) content. The treatments consisted of weed management practices *viz*., pre emergence herbicide oxyfluorfen, and post emergence herbicide *viz.*, imazethapyr, and those herbicides used either alone or combined. In addition, one hoeing at 21 DAS were tested with unweeded check. Pre and post emergence herbicides were applied at 3 DAS and 15-20 DAS respectively using a knap sack sprayer fitted with a flat pan nozzle using 500 litres of water/ha.

The seeds of groundnut were treated with *Trichoderma viride* at the rate of 2 g/kg of seed. Seeds were sown in lines at 30 cm apart and 10 cm between plants. The entire dose of recommended fertilizers (17:34:54 kg NPK/ha) were applied basally before sowing in the form of urea, single super phosphate and muriate of potash. Gypsum at the rate of 400 kg/ha was applied in two equal splits, one at basal and another at the time of ear thing up on 40 DAS. To account for the general weed flora of the experimental field, species wise weeds observed in the unweeded control plots were recorded at the period of maximum appearance of 30 days after sowing. Ten plants were selected at random in each plot and were tagged for recording the observations of the growth, yield attributes and yield. Crop was harvested at maturity, threshed and plot-wise seed and yields in kg/ha was recorded. Net returns were calculated based on the prevailing market prices during the experimentation. The Benefit Cost (B:C) ratio was based on gross returns. Weed control efficiency and weed index were calculated by using the formula (Gill and Vijaya Kumar, 1969).

$$\text{WCE (\%)} = \frac{\text{Dry matter of weeds in unweeded plot} - \text{Dry matter of weeds in treated plot}}{\text{Dry matter of weeds in unweeded plot}} \times 100$$

Table 1: Weed density (no/0.25m2) Weed Dry Weight (g/0.25 m2), weed Control Efficiency (%) in Rabi Groundnut as Influenced by weed management practices

Treatments	Weed density (no/0.25m2)			Weed dry matter weight (g/0.25 m2)			Weed control efficiency (%)		
	20 DAS	40DAS	60DAS	20 DAS	40DAS	60DAS	20 DAS	40DAS	60DAS
T1-control,	90.3	108.4	69.8	56.62	64.81	46.6	-	-	-
T2-one hoeing at 21 DAS(Farmer Practice)	32.4	42.4	27.9	16.23	23.8	17.42	71.33	63.27	62.61
T3-Oxyfluorfen 23.5 EC @ 0.2kg ha^{-1} at 2 DAS fb Imazethapyr 10 percent SL @ 100 g ha^{-1} at 15 DAS	21.2	33.1	12.3	10.8	15.3	11.6	80.92	76.39	75.10

Table 2: Effect of weed management practices on growth, yield in Rabi Groundnut

Treatments	Plant height(cm)	No of pods/plant	Pod Yield (qtl ha^{-1}),
T1-control,	61	12.1	10.3
T2-one hoeing at 21 DAS(Farmer Practice)	67.3	21.9	18.4
T3-Oxyfluorfen 23.5 EC @ 0.2kg ha^{-1} at 2 DAS fb Imazethapyr 10 percent SL @ 100 g ha^{-1} at 15 DAS	71.3	25.2	22.7

Table 3: Effect of weed management practices on Economics in Rabi Groundnut

Treatments	Cost of cultivation (Rs. ha^{-1})	Net return (Rs. ha^{-1})	Benefit cost ratio
T1-control,	35753	14614	1.40
T2-one hoeing at 21 DAS(Farmer Practice)	43652	46324	2.06
T3-oxyfluorfen 23.5 EC @ 0.2kg ha^{-1} at 2 DAS fb Imazethapyr 10 percent SL @ 100 g ha^{-1} at 15 DAS	39694	71309	2.79

Results and Discussion

Weeds flora

The dominant weed flora in the experimental field were *Cyperus rotundus, Dactyloctenium aegypteium, Digera arvensis, Tridex procumbens, Phyllantusniruri, Commelina benghalensis, Eclipta alba, Chenopodium album, Parthenium* spp. *Cynodon dactylon, Echinochloa* spp. and *Digitaria sanguinalis*

Effect of treatment on weed parameters

Weed density

From the Table 1 it was observed that the application of Oxyfluorfen 23.5 ec @ 0.2kg ha-1 at 2 DAS fb Imazethapyr 10 percent SL @ 100 g ha-1 at 15 DAS (T3) recorded the lowest weed density than one hoeing at 21 das(T2) and control i.e. 21.2, 33.1 and 12.3 on 20, 40 and 60 das respectively. Application of Oxyfluorfen herbicide might have been kill broad leaved seedlings through contact action and cell membrane disruption, since light is required for herbicidal activity, diphenyl ether phytotoxicity is related to the process of photosynthesis and inhibition of both electron transport and ATP synthesis. Thus, broad leaved weeds were effectively controlled with the herbicide. Imazethapyr acts by inhibiting the enzyme acetohydroxy acid synthase (AHAS) thereby reducing the levels of three amino acids (isoleucine, leucine and valine) which cause the disruption of protein synthesis and other subsequent biochemical reaction which in turn inhibits the plant growth. Weedy check recorded the maximum weed density 90.3, 108.4 and 69.8 at 20, 40 and 60 DAS respectively.

Weed dry weight and Weed control efficiency (WCE)

Weed dry weight is the most important parameter to access the weed competitiveness for the crop growth and productivity [Table-1]. The data depicted that the application of Oxyfluorfen 23.5 ec @ 0.2kg ha-1 at 2 DAS fb Imazethapyr 10 percent SL @ 100 g ha-1 at 15 DAS (T3) there was reduction of weed dry weight i.e. 15.3 and 11.6 g/m2 40 DAS TO 60 DAS respectively. The lower weed dry weight with herbicidal weed management in groundnut due to lesser total weed density and higher weed control efficiency. Weed control efficiency indicates the comparative magnitude of reduction in weed dry weight by weed control treatments [Table-1]. Due to reduced weed population, weed dry weight was very much reduced in the treatments. Weed control efficiency was highly influenced by different treatments at various growth stages of crop. The weed control efficiency was higher with application of Oxyfluorfen 23.5 ec @ 0.2kg ha-1 at 2 DAS fb Imazethapyr 10 percent SL @ 100 g ha-1 at 15 DAS (T3) than hand weeding which varies from 80.92, 76.39 and 75.10 percent at 20, 40 and 60 DAS respectively as compared to one hoeing at 21 DAS (T2) where the WCE was 71.33, 63.27 and 62.61 percent at 20, 40 and 60 DAS respectively. This might be due to effect of weed during initial stages of crop growth with herbicide application.

Effect of treatments on crop parameters

Yield

An appraisal of data presented in table-2 showed that various weed management practices significantly influenced growth and yield attributes of groundnut. The highest plant height, pods/plants, was recorded application of Oxyfluorfen 23.5 ec @ 0.2kg ha-1 at 2 DAS fb Imazethapyr 10 percent SL @ 100 g ha-1 at 15 DAS i.e. 71.3cm and 25.2 as compared to other two practices. The reason might be due to better weed control by optimum usage of herbicide, which provided conducive environment favouring higher nutrient uptake that reflected on higher plant height, leaf area index and better source sink relationship. Unweeded control resulted in shorter plants, obviously due to the competitive effect of weeds throughout the crop growth. All the growth-attributing characters, which were dominant in different weed control methods, favoured to bear more number of pods than weedy check. The pod yield with application of Oxyfluorfen 23.5 EC @ 0.2kg ha-1 at 2 DAS fb Imazethapyr 10 percent SL @ 100 g ha-1 at 15 DAS found to be highest i.e. 22.7kg/ha as compared to one hoeing at 21 DAS (T2) and control which was 18.4 and 10.3 kg/ha respectively. This might due to weed free environment and effective utilization of applied inputs and natural resources by the crop. When weeds were not controlled up to the critical period of crop, weed competition on plants for crop growth resources occur leading to inferior yield attributing traits like matured pods/plant and lower pod yield. This would have reflected in poor pod yield under unweeded control. Presence of weeds throughout the growing season caused poor crop growth and yield reduction in unweeded check.

Economics

Among the weed control treatments recommended application of Oxyfluorfen 23.5 EC @ 0.2kg ha-1 at 2 DAS fb Imazethapyr 10 percent SL @ 100 g ha-1 at 15 DAS recorded higher net returns (71309 Rs. ha-1) and higher B:C ratio (2.79). one hoeing at 21 DAS (T2) recorded lower net returns (Rs.46324/-) and low B:C ratio 2.06 this might be due to the cost of cultivation of groundnut was increased in treatment weed free check due to higher need of human labours and their wages. Weedy check recorded lowest net returns (Rs.14614) and B:C ratio (1.40). The increased income realized with these two treatments might be due to higher pod yield obtained due to the treatment efficiency, which would have reduced the competition between weeds and crop for water and nutrients Though the traditional method of hand weeding effectively minimizes the weed competition and maximizes the yield and higher net return, the B:C ratio would be less compared to above mentioned weed control treatment. This might to be more labor and higher wages resulted in higher cost of cultivation.

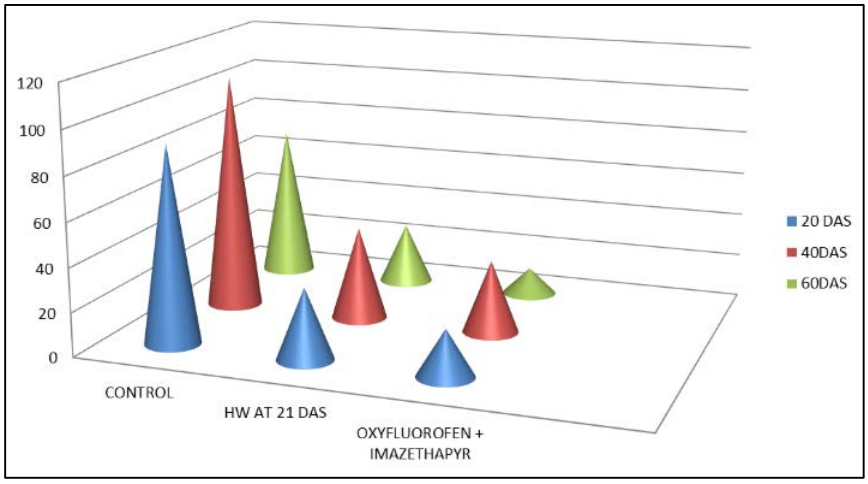

Fig 1: Effect of weed management practices on weed density of groundnut

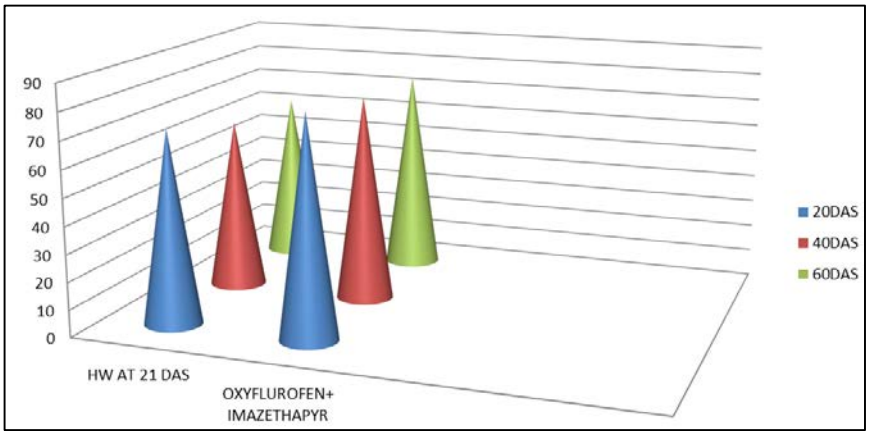

Fig 2: Effect of weed management practices on Weed control efficiency (%) of groundnut

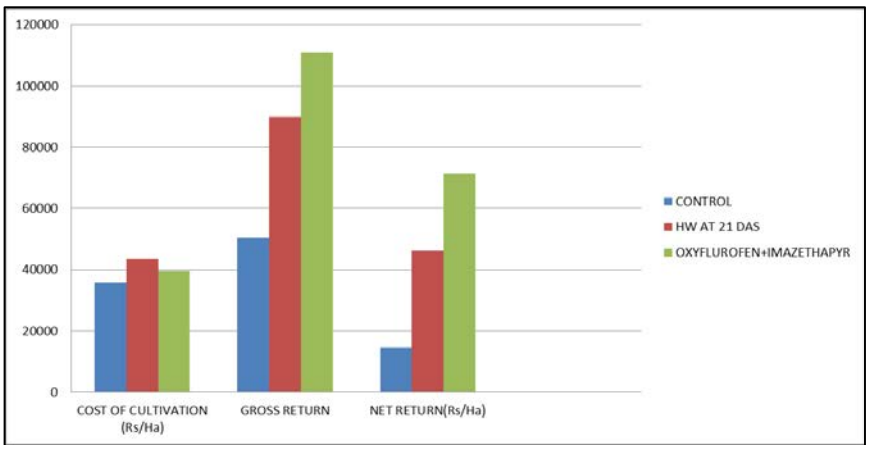

Fig 3: Effect of weed management practices on economics of groundnut

Conclusion

Based on these results it can be concluded that application of Oxyfluorfen 23.5 EC @ 0.2kg ha-1 at 2 DAS fb Imazethapyr 10 percent SL @ 100 g ha-1 at 15 DAS was proved practically more convenient and economically best feasible integrated weed management practice for groundnut considering the present condition of scarcity and high cost of labours, quality of weed control, yield and B:C ratio of cultivation of Groundnut.

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