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Efficacy of rice cum *dhaincha* (*Sesbania aculeata*) intercropping on weed control, growth, yield and economics of rice

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Abstract
On farm trail was carried out during wet season of 2012 at farmer's field of South Andaman. The experiment was laid out in randomized block design with five replications. At, 20 DAT, higher weed control efficiency (WCE) (68.9%) was recorded in application of butachlor at 1.25 kg/ha at 3 DAT*fb* hand weeding (HW) at 30 DAT (T_3). This was followed by intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT (T_4). Whereas, at 40 DAT, higher WCE registered under intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT which was onpar with application of butachlor at1.25 kg/ha at 3 DAT*fb* hand weeding at 30 DAT. Significantly higher grain (5.23 t/ha) and straw yield (8.14 t/ha) was recorded withapplication of butachlor at 1.25 kg/ha on 3 DAT *fb* HW on 30 DAT (T_3). This was on par with intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT (T_4) led to 35.1 % higher grain yield over unweeded check. Application of butachlor at 1.25 kg/ha on 3 DAP *fb* HW at 30 DAT registered the highest net return (Rs.32650/-) as well as benefit cost ratio of 2.66.

Keywords: Butachlor, *Dhaincha*, 2, 4-D Na salt, growth, yield, economics

Introduction
Rice is major staple food crop of Andaman and Nicobar Islands. Rice is cultivated in an area of 5341 ha with the productivity of 3.15 tonnes per ha (A & N Administration, 2018) [1]. Rice production of island is reducing day by day due to adoption of photo sensitive rice variety, high scarcity of labour, high input cost inclement weather and lack of competitive prices. Farmers are encountering the problem of low return from rice cultivation and other major factors like biotic and abiotic constraints are affect rice productivity of these islands. High rainfall and climatic conditions are more conducive for weed growth which depletes natural resources such as nutrients, water and light. Scarcity of inorganic fertilizers and high costs of organic manures also major constrain in lowland rice production. Island agriculture is facing challenges to meet out self-sufficiency for growing as well as floating (tourist) population by using limited available land resources with innovative technologies to enhance rice productivity. Warm and humid conditions with temperature ranging from 23 to 30ºC, relative humidity and higher average annual rainfall favour the natural proliferation of weeds. The manual method of weeding is effective methods, whereas its time consuming and laborious one. Generally, farmers are practicing pre emergence herbicides which fails to control late emerging weeds due to high unexpected high intensity of rainfall. Intercropping of *dhaincha* in rice and incorporating it with either manual/conoweeder or manual + conoweeder gave higher grain yield compared to sole rice (Ravisankar *et al.*, 2008) [11]. Anitha and Mathew (2010) [2] reported that concurrent culture of rice and *dhaincha* reduced the 72 % weed density and 57 % weed dry matter production and reduce use of nitrogen fertilizers approximately by 25 % without affecting grain yield as compared to sole crop of rice. The present investigation is undertaken in this background to find out efficacy of rice cum *dhaincha* on weed control, growth, yield and economics of rice.

Materials and methods
On farm trail was carried out during wet season of 2012 at farmer's field of South Andaman. The soil was clay loam in texture having pH of 6.7, normal EC of 0.18 dS/m, organic carbon content of 0.56%, lower in available nitrogen of 165 kg/ha, medium in phosphorus (11.8 kg/ha) and low in available potassium (105.3 kg/ha). The experiment was laid out in randomized block design with five replications. The weed control treatments viz., T_1- Unweeded check (Control), T_2- Hand weeding twice at 15 and 30 DAT, T_3- Application of

butachlor at 1.25 kg/ha on 3 DAT *fb* hand weeding at 30 DAT, T_4-Intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT. Seedling of *"Gayatri"* rice variety were raised and transplanted 20 days old seedlings with spacing of 20 cm x 15 cm. Crop was transplanted IInd week of July after transplanting immediately broadcasted 20 kg *dhaincha* seeds /ha. The recommended dose of fertilizer 90:60:60 kg /ha was applied through urea, rock phosphate and muriate of potash. Full dose of phosphorus and half dose potassium was applied as basal dose. Nitrogen was applied in three split at 10 DAT, active tiller and panicle initiation stage and remaining half dose of potassium was applied at panicle initiation stage. Need based plant protection measures were given whenever the incidence more than economic threshold level. All other recommended package of practices was adopted as per the schedule. The observation on weed density and weed dry weight was recorded at 20 and 40 days after transplanting (DAT). For weed dry weight, weeds were uprooted and washed with water, shade dried and dried with hot air oven at 70ºC for 48 hours. Leaf area index (LAI) and root length and root dry weight were registered at flowering stage. Plant height, productive tillers, panicle length and weight, grain yield and straw yield were recorded at the time of harvest. The pertaining to weeds were transformed to square root of x +2 and statistical analysis as per Gomez and Gomez (1984) [7] with 5 % level of significance to interpret the treatment differences.

Result and discussion

Weed flora

The predominant weed of experimental field were *Echinochloa colonum, Cynodon dactylon* and *Setaria glauca* among grasses, *Cyperus haspan, Cyperus iria, Cyperus eragrostis, Cyperus difformis,* and *Fimbristylis miliacea* among sedges and *Monochoria vaginalis, Marsilea quadrifolia, Sphenoclea zeylanica, Ammannia baccifera,* and *Bergia capensis* among BLW were observed during the entire crop growth season.

Effect of weed density and dry weight

Weed management practices showed significant influence on weed density and weed dry weight at 20 and 40 DAT (Table 1). At 20 DAT, lower weed density of 34.0m^2 was recorded with application of butachlor at 1.25 kg/ha on 3 DAT *fb*HW at 30 DAT. This was followed by hand weed twice at 15 and 30 DAT and intercropping of *dhaincha fb* 2,4-D sodium salt at 0.5kg/ha on 30 DAT. Whereas, at 40 DAT, lower density of 24.5 m^2 was recorded under intercropping of *dhaincha fb* 2,4-D sodium salt at 0.5kg/ha on 30 DAT (T_4) which was on par with application of butachlor at 1.25 kg/ha on 3 DAT *fb* hand weeding at 30 DAT(T_3). It might be due to smothering effect of *dhaincha* reduced weed density and dry weight. Similar resultwas reported by Singh and Singh(2007) [12] who has registered that intercropping of brown manuring crop with rice reduced weed density by 40-50%.The higher weed density was recorded in unweeded check (control) (T_1).

The lowest weed dry weight was recorded in application of butachlor at 1.25 kg/ha on 3 DAT *fb* hand weeding at 30 DAT(T_3). This was followed by intercropping of *dhaincha fb* 2,4-D sodium salt at 0.5kg/ha on 30 DAT (T_4) and hand weeding twice at 15 and 30 DAT (T3) at 20 DAT. These two treatments were on par with each other. Similar trend was observed at 40 DAT. It might be due to decrease availability of sunlight to the late emerging weed seeds whichis inhibited the weed seed germination and photosynthesis. The similar finding was reported by Chauhan and Mahajan (2014) [5]. The higher weed dry weight was observed under unweeded check (control).

Table 1: Effect of rice cum *dhaincha* intercropping on total weed density, weed dry weight and weed control efficiency of rice

Treatments	Total weed density (nos./m^2)		Total weed dry weight (g/m^2)		Weed control efficiency (%)	
	20 DAT	40 DAT	20 DAT	40 DAT	20 DAT	40 DAT
T_1– Unweeded check (Control)	12.99 (167.0)	15.95 (253.0)	10.54 (109.6)	11.42 (128.9)	0	0
T_2 – Hand weeding twice on 15 and 30 DAT	8.14 (65.0)	6.04 (34.7)	6.06 (35.0)	4.41 (17.8)	61.1	86.3
T_3 - Application of butachlor @1.25 kg/ha on 3 DAT *fb* hand weeding on 30 DAT	5.98 (34.0)	5.21 (25.2)	5.03 (23.3)	3.94 (13.6)	79.6	90.0
T_4 – Intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT	7.34 (52.0)	5.13 (24.5)	6.80 (44.3)	4.04 (14.3)	68.9	90.3
SEd	0.45	0.38	0.39	0.35	-	-
CD (P=0.05)	0.97	0.82	0.84	0.76	-	-

Weed control efficiency

At, 20 DAT, higher weed control efficiency of 68.9% was recorded in application of butachlor at1.25 kg/ha on 3 DAP *fb* hand weeding at 30 DAT (T_3). This was followed by intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT (T_4). Whereas, at 40 DAT, higher weed efficiency registered under intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT (T_4) which was on par withapplication of butachlor at1.25 kg/ha on 3 DAT*fb* hand weeding at 30 DAP (T_3). This may be due to integration of *dhaincha* found to be more effective in smothering of weed growth which led to reducing weed density and weed dry weight. The similar line of findings reported by Joseph *et al.* (2008) [8].

Effect on crops

Growth attributes

Plant growth attributes like plant height, LAI, root length, root dry weight and dry matter production significantly influenced by weed management practices (Table 2). Application of butachlor at 1.25 kg/ha on 3 DAT*fb* hand weeding at 30 DAT (T_3) recorded taller plant (144.0cm) which was on par with intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT (T_4). It may be due superiority of pre emergence herbicide during initial stage of crop growth whereas, late emerging weeds were removed by hand weeding resulted favourable condition for crop growth and development. The results were in conformity with the findings of Kumar *et al.* (2015) [9].

Intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT (T_4) recorded higher root length, root dry weight of 3.0 cm, 6.8 g/hill, respectively as compared to unweeded check. This was on par with application of butachlor at 1.25 kg/ha on 3 DAT *fb* hand weeding at 30 DAT (T_3). It might be owing to reduced weed density which facilitates the crop roots to extract more water and nutrients for its metabolic activities. This results were in conformity with the findings of Bommayasamy *et al*. (2018) [3]. The lowest root length, root dry weight and DMP recorded in unweeded check (T_1). Application of butachlor at 1.25 kg/ha on 3 DAT*fb* hand weeding at 30 DAT (T_3) and intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT (T_4) recorded 52.6 and 43.6% higher DMP respectively as compared to unweeded check (T_1).

Significant difference on yield attributes like number of productive tillers/m^2, filled grains/panicle, panicle length, panicle weight was recorded with different weed management practices whereas test grain weight did not show much variation between treatments (Table 3). Maximum number of 332 and 200.1of productive tillers/$m^2$and number of filled grains/panicle respectively recorded under intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT which was comparable with application of butachlor at 1.25 kg/ha on 3 DAT *fb* hand weeding on 30 DAT (T_3). These two treatments were 45.6, 29.4% and 31.8, 25.5% higher productive tillers and filled grains/panicle recorded as compared to unweeded check. This was probably due to intercropping of *dhaincha* and its in-situ conservation release adequate amount of nutrient at critical stages of crop growth which meet out crop demand throughout growth period. The similar findings were reported by Anitha and Mathew (2010) [2]. Application of butachlor at 1.25 kg/ha on 3 DAT *fb* hand weeding at 30 DAT (T_3) recorded 24.7 and 19.6% higher panicle weight and panicle length respectively as compared to unweeded check. Significantly higher grain (5.23 t/ha) and straw yield (8.14 t/ha) was recorded withapplication of butachlor at 1.25 kg/ha on 3 DAT *fb* hand weeding at 30 DAT (T_3). This was on par with intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT (T_4) led to 35.1 % higher grain yield over unweeded check. It might be due to effective weed control achieved through reduced weed dry weight accumulation which favoured higher nutrient uptake by crops results in the production of more yield. It corroborated the findings of Bommayasamy and Chinnamuthu (2018) [4]; Deepthi Kiran and Subramanyam (2010) [6]. Straw yield also followed similar trend as that of grain yield.Application of butachlor at 1.25 kg/ha on 3 DAT *fb* hand weeding at 30 DAT registered the highest net return (Rs.32650/-) as well as benefit cost ratio of 2.66. This might be owing to higher weed control efficiency with least man days's engagement and higher grain yield. The similar result reported by Maity *et al*. (2009) [10].

It is concluded that intercropping of *dhaincha fb* 2,4-D sodium salt on 30 DAT recorded on par yield with application of butachlor at 1.25 kg/ha on 3 DAT *fb* hand weeding at 30 DAT in addition to that enhancing soil health by in-situ incorporation of biomass.

Table 2: Effect of rice cum *dhaincha* intercropping on growth attributes of rice

Treatments	Plant height (cm)	LAI	Root characters		DMP (t/ha)
			Root length (cm)	Root dry weight/ hill (g)	
T_1– Unweeded check (Control)	129.2	4.17	23.4	15.2	8.76
T_2 – Hand weeding twice on 15 and 30 DAT	134.2	4.96	24.8	17.5	10.79
T_3 - Application of butachlor at1.25 kg/ha on 3 DAT*fb* hand weeding on 30 DAT	144.0	5.49	26.0	21.4	13.37
T_4 – Intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT	141.1	5.36	26.4	22.0	12.58
SEd	5.0	0.25	0.9	1.0	0.32
CD (P=0.05)	10.7	0.54	2.2	2.2	0.69

Table 3: Effect of rice cum *dhaincha* intercropping on yield attributes, yield and economics of rice

Treatments	Protective tillers/m^2	No of filled grains/panicle	Panicle weight (g)	Panicle length (cm)	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Gross return (Rs.)	Net return (Rs.)	B:C ratio
T_1– Unweeded check (Control)	228	151.8	2.23	22.5	17.7	3.62	5.14	36200	16800	1.87
T_2 – Hand weeding twice on 15 and 30 DAT	264	171.7	2.54	25.5	18.5	4.28	6.51	42800	21300	1.99
T_3 - Application of butachlor @1.25 kg/ha on 3 DAT *fb* hand weeding on 30 DAT	295	190.5	2.78	26.9	19.1	5.23	8.14	52300	32650	2.66
T_4 – Intercropping of *dhaincha fb* 2-4 D sodium salt at 0.5 kg/ha on 30 DAT	332	200.1	2.55	26.4	18.8	4.89	7.69	48900	28190	2.36
SEd	20	9.3	0.09	1.5	1.09	0.32	0.38	-	-	-
CD (P=0.05)	43	20.3	0.19	3.2	NS	0.69	0.83	-	-	-

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