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Effect of Brown manuring on Weed Dynamics, Available Soil Moisture and Growth Attributes in Irrigated Maize (*Zea mays* L.)

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A field experiment was conducted at Agricultural College and Research Institute, Madurai during late rabi 2011 – 2012 to elucidate the effect of brown manuring on weed dynamics, available soil moisture and growth attributes of irrigated maize. The results revealed greater reduction in dryweight of grasses, sedges, broad leaved weeds and total weeds in PE alachlor 1.0 kg ha $^{-1}$ + brown manuring at all the stages of crop and was at par with PE alachlor 1.0 kg ha $^{-1}$ +daincha as intercrop with *in-situ* incorporation on 35 DAS. Available soil moisture content, was more with PE alachlor 1.0 kg ha^{-1} + brown manuring followed by PE alachlor 1.0 kg ha^{-1} +daincha as intercrop with *in-situ* incorporation irrespective of depth of soils and stages of crop. The above two treatments also had equal effect in enhancing the growth attributes such as plant height, plant DMP and LAI at 20 and 40 DAS. Whereas, at 60 DAS, PE alachlor 1.0 kg ha $^{-1}$ + brown manuring was superior in increasing growth attributes of irrigated maize.

Key words: Irrigated maize, Brown manuring, weed dry weight, available soil moisture, growth attributes.

Maize is one of the most important crops and is considered as queen of the cereals. In India, it is cultivated in an area of 8.0 million hectares with a production of 16.78 million tonnes and a productivity of 2000 kg ha^{-1}, thereby contributing 7 per cent to food basket of the country (Anon., 2008). The crop needs mild climate during early stage and peak vegetative stage and dry matter accumulation with higher rates at these stages is vital so as to enhance the partitioning of assimilates to reproductive parts which help to increase the maize yield. It could be achieved by making available of all the major resources like water, nutrients, space and light at early and vegetative stage of the crop. On the other hand, slow growing nature of the maize with wider spacing during the above stages leading to more crop weed competition resulting in lesser growth and development of the crop and finally yield.

Several weed control measures are in practice in maize. The new strategy which has just emerged in India is brown manuring. It aimed at suppressing the weeds without affecting the soil physico and chemical properties and its associated microbes. It can be achieved through raising green manure crops such as daincha, sunhemp etc. as intercrop and killing the same by application of post emergence herbicides. The killed manure is allowed to remain in the field along with main crop without incorporation / *in-situ* ploughing until its residues completely decompose in soil to add organic manure despite weed suppression by its shade effect. Given the post-emergence spray on green manure leaves resulting in loss of chlorophyll in leaves showing brown colour is described as brown manuring (Tanwar *et al.*, 2010). Brown manuring also helps in suppressing the weeds upto 50 per cent of total weed population on the account of the shade effect of killed green manure till 45 DAS upto which the critical period of crop weed competition continues in maize. Keeping these points in view, a study was undertaken to investigate the effect of brown manuring on weed dynamics, available soil moisture content and growth attributes in irrigated maize.

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Materials and Methods

A field experiment was conducted during late rabi 2011-2012 at Agricultural College and Research Institute, Madurai. The experiment was laid out in randomized block design with seven treatments replicated thrice (Table1).The treatments were T_1-Mechanical weeding by hand hoe on 20 and 35 DAS (Days after sowing), T_2- PE application of Alachlor @ 1.0 Kg ha^{-1} followed by Mechanical weeding by hand hoe at 35 DAS, T_3-Daincha as intercrop with *in-situ* incorporation on 35 DAS, T_4-Daincha as intercrop and killing by 2, 4 –D on 35 DAS (Brown manuring), T_5- PE Alachlor @ 1.0 Kg ha^{-1}+ Daincha as intercrop with *in-situ* incorporation on 35 DAS, T_6- PE Alachlor @ 1.0 Kg ha^{-1} + Brown manuring, T_7-Un weeded check.

The soil was clay loam in texture, low in organic carbon (0.23%) and available N (261.2kg ha^{-1}),

medium in P_2O_5 (21.4 kg ha^{-1}) and high in K_2O (256.5 kg ha_{-1}). The maize hybrid CoH (M) 5 was sown with recommended espacement of 60 x 25cm. In between the rows of maize, two rows of daincha were sown with an intra row spacing of 20 cm in the respective treatments as per treatment schedule. The sowing of maize and daincha was taken up simultaneously. A blanket recommendation of 135:62.5:50 kg NPK ha_{-1} was followed.

All the recommended package of practices except brown manuring and weed control were adopted in the experimental plot. Calibrated quantity of herbicides was applied as aquous spray (500 lit ha_{-1}) with knapsack sprayer. Hoeing with hand hoe was given in the respective treatments of mechanical weeding by hand hoe as per schedule. Pre emergence application of alachlor was given @1.0 kg ha_{-1} on 3_{rd} DAS in the respective treatments. In brown manuring treatments plots, sesbania (Daincha) and maize were grown together for 35 days and thereafter, sesbania was knocked down with the use of 2, 4-D spray @ 0.5 kg ha_{-1}.

All growth attributes viz. plant height, LAI and Plant DMP were recorded at different stages of crop growth. Soil moisture at 0-15 cm and 15-30 cm depths was estimated gravimetrically for all the treatments and expressed as percent content.

Results and Discussion

Effect on weeds

The results of the experiment revealed that PE alachlor @ 1.0 kg ha_{-1} + brown manuring (T6) had significantly lesser DMP of grasses, sedges, broad leaved weeds and total weeds at 20, 40 and 60 DAS (Table 1). However, it was on par with PE alachlor @ 1.0 kg ha_{-1} + daincha as intercrop with in-situ incorporation on 35 DAS (T5). It might be attributed to effective weed control by PE alachlor during early stages up to 20 DAS and suppression of weeds thereafter through the shade effect of standing daincha crop residue under brown manuring and rapidly grown canopy coverage of maize at later stages upto 60 DAS. This is in conformity with the findings of Samar singh *et al.* (2007). The recommended practice of PE alachlor @ 1.0 kg ha_{-1} and mechanical weeding by hand hoe at 35 DAS (T2) and farmers practice of mechanical weeding by hand hoe on 20 and 35 DAS (T1) ranked 3_{rd} and 4_{th}, respectively in checking the DMP of weeds irrespective of stages (Table 1). Regeneration of weeds due to mechanical weeding on 35 DAS in

Table 1. Effect of brown manuring on DMP of grasses, sedges, broad leaved weeds and total weeds (g m_{-2}) in Maize

Treatment	DMP of weeds at 20DAS				DMP of weeds at 40DAS				DMP of weeds at 60DAS			
	Grasses	Sedge	Broad leaved weeds	Total weeds	Grasses	Sedge	Broad leaved weeds	Total weeds	Grasses	Sedge	Broad leaved weeds	Total weeds
T_1- Mechanical weeding by Hand hoe on 20 and 35 DAS	21.25 (1.36)	18.91 (1.32)	25.58 (1.44)	65.74 (1.83)	5.75 (0.88)	5.75 (0.89)	6.91 (0.94)	18.41 (1.31)	9.75 (1.07)	9.16 (1.04)	8.76 (1.03)	27.67 (1.47)
T_2 - PE Alachlor @ 1.0 Kg ha_{-1} fb Mechanical weeding by Hand hoe at 35 DAS	7.50 (0.97)	7.98 (0.99)	9.50 (1.06)	24.98 (1.43)	5.83 (0.89)	5.59 (0.88)	6.58 (0.93)	18.00 (1.30)	9.41 (1.05)	8.66 (1.02)	8.58 (1.02)	26.65 (1.45)
T_3- Daincha as intercrop with in-situ incorporation on 35 DAS	10.41 (1.09)	11.26 (1.12)	12.83 (1.17)	34.50 (1.56)	6.75 (0.94)	6.91 (0.95)	8.80 (1.03)	22.46 (1.38)	11.91 (1.14)	11.25 (1.12)	11.25 (1.12)	34.41 (1.56)
T_4- Brown manuring	10.22 (1.08)	11.01 (1.10)	12.50 (1.16)	33.73 (1.55)	6.33 (0.92)	6.75 (0.94)	8.63 (1.02)	21.71 (1.37)	11.51 (1.13)	11.16 (1.11)	11.10 (1.11)	33.77 (1.55)
T_5- PE Alachlor @ 1.0 Kg ha_{-1}+ Daincha as intercrop with in-situ incorporation on 35 DAS	5.48 (0.87)	5.25 (0.86)	7.13 (0.96)	17.86 (1.29)	4.75 (0.82)	4.25 (0.79)	4.75 (0.82)	13.75 (1.19)	7.90 (0.99)	6.58 (0.93)	6.76 (0.94)	21.24 (1.36)
T_6- PE Alachlor @1.0 kg ha_{-1} +brown manuring	5.25 (0.86)	4.94 (0.84)	6.80 (0.94)	16.99 (1.27)	4.48 (0.81)	3.98 (0.77)	4.47 (0.81)	12.93 (1.17)	6.52 (0.93)	5.45 (0.87)	5.26 (0.86)	17.23 (1.28)
T_7- Un weeded check	21.25 (1.36)	19.91 (1.34)	26.05 (1.44)	68.55 (1.84)	28.27 (1.48)	26.75 (1.45)	23.23 (1.54)	88.25 (1.95)	35.08 (1.56)	34.72 (1.56)	39.73 (1.62)	109.53 (2.04)
CD (P=0.05)	0.04	0.03	0.04	0.06	0.04	0.03	0.03	0.05	0.04	0.05	0.05	0.05

Figure in the parenthesis are log (x+2) transformed values.

Table 2. Effect of brown manuring on available soil moisture content at various stages in Maize

Treatment	15 DAS		30 DAS		45 DAS		60 DAS	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
	ASM (%)	ASM (%)	ASM (%)	ASM (%)	ASM (%)	ASM (%)	ASM (%)	ASM (%)
T_1- Mechanical weeding by Hand hoe on 20 and 35 DAS	10.43	11.88	20.89	22.75	22.89	26.46	33.89	35.46
T_2 - PE Alachlor @ 1.0 Kg ha_{-1} fb Mechanical weeding by Hand hoe at 35 DAS	17.82	18.52	21.76	23.97	24.95	28.78	35.45	37.78
T_3- Daincha as intercrop with in-situ incorporation on 35 DAS	11.43	12.69	13.52	14.71	16.68	17.82	22.76	24.93
T_4- Brown manuring	12.62	13.85	14.45	15.82	18.56	19.89	26.64	28.97
T_5 - PE Alachlor @ 1.0 Kg ha_{-1}+ Daincha as intercrop with in-situ incorporation on 35 DAS	18.42	19.81	22.87	24.23	27.23	33.94	37.23	40.94
T_6 - PE Alachlor @1.0 kg ha_{-1} +brown manuring	19.64	20.25	23.35	26.46	29.45	35.38	39.45	42.38
T_7- Un weeded check	10.31	11.03	11.21	12.62	12.53	12.72	15.64	16.79

recommended practice (T2) could be the reason for less effect in checking the weed DMP though it was given with PE alachlor which could keep the weeds under check upto 20 DAS only. Similarly, in the case of farmers practice (T1), regeneration of weeds is still high after each weeding given at 20 and 35 DAS. Among the treatments, unweeded check (T7) had higher weed DMP of grasses, sedges, broad leaved weeds and total weeds at all the stages of crop (Table 1) except at 20 DAS at which it was comparable with farmer's practice of mechanical weeding by hand hoe on 20 and 35 DAS (T1) in which no treatment was imposed till 20 DAS.

Effect on available soil moisture content

Irrespective of stages of crop (15, 30, 45 and 60 DAS) and soil depths (0-15 and 15-30 cm) the available soil moisture content was higher with PE application of alachlor @ 1.0 kg ha^{-1} + brown manuring (T6) than remaining treatments and the same was closely followed by PE alachlor @ 1.0 kg ha^{-1} + daincha as intercrop with in-situ incorporation

Table 3. Effect of brown manuring on plant height, DMP and leaf area index at 20, 40 and 60 DAS in maize

Treatment	Plant height (cm)			DMP (kg ha^{-1})			Leaf area index		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
T_1- Mechanical weeding by hand hoe on 20 and 35 DAS	52.00	107.23	142.83	1820	5438	9283	0.79	2.86	4.69
T_2 - PE alachlor @ 1.0 Kg ha^{-1} fb Mechanical weeding by Hand hoe at 35 DAS	73.51	108.45	145.89	2505	5530	9482	2.09	2.91	4.76
T_3- Daincha as intercrop with in-situ incorporation on 35 DAS	66.43	95.67	130.14	2305	4839	8459	1.38	1.82	3.45
T_4- Brown manuring	67.62	96.23	133.31	2376	4937	8665	1.46	1.93	3.59
T_5 - PE alachlor @ 1.0 Kg ha^{-1}+ Daincha as intercrop with in-situ incorporation on 35 DAS	78.23	119.94	155.68	2728	6061	10519	2.94	3.85	5.75
T_6 - PE alachlor @1.0 kg ha^{-1} +brown manuring	79.97	120.23	168.23	2798	6161	10934	2.98	3.94	6.78
T_7- Un weeded check	51.17	60.12	72.34	1750	3066	4702	0.76	1.19	2.34
SEd	1.12	1.75	4.23	61.2	94.6	118.9	0.04	0.07	0.06
CD (P=0.05)	2.43	3.81	9.22	133.3	206.2	259.3	0.09	0.16	0.13

on 35 DAS (T5) (Table 2). This might be due to better weed control noticed in the above treatments which resulted in higher available soil moisture content throughout the crop period. Sharma *et al.* (2010) found that live mulch with sunhemp (C*rotalaria juncea* L.) intercropped with maize was beneficial in conserving moisture. They also observed that pre-emergence alachlor was beneficial for improving moisture conservation. The recommended practice of PE alachlor @ 1.0 kg ha^{-1} followed by mechanical weeding by hand hoe at 35 DAS (T2) also performed better next to that of above said treatments in respect of available soil moisture content (Table 2).

Unweeded check (T7) had lesser available soil moisture content at all the stages of crop (Table 2). It was evident from higher weed dry matter production recorded in this treatment which could have absorbed more soil moisture under unweeded situation.

Effect on growth attributes

Reduced crop weed competition to a greater extent throughout the crop growth period in PE alachlor @ 1.0 kg ha^{-1} + brown manuring (T6) due to weed free environment helped maize crop to grow taller, have more dry matter production and increased leaf area index (LAI) significantly (Table 3). The above effect was seemed to be similar in PE alachlor @ 1.0 kg ha^{-1} + daincha as intercrop with in-situ incorporation on 35 DAS (T5) upto 40 DAS as both of the above treatments were given with alachlor as pre-emergence application and on 35 DAS only varying treatments were imposed and hence no variation. The treatment PE alachlor @ 1. 0 kg ha^{-1} + brown manuring (T6) sprayed with 2,4-D on daincha being the brown manuring showed significant increase on the above parameters at 60 DAS as compared to other treatments. The prominent treatment (T_6) increased the plant height (53.7, 12.3 and 117.7 percent) dry matter production (53.7, 13.3 and 17.7 percent) and leaf area index (277.2, 37.7 and 44.5 percent) over unweeded check (T_7) at 20, 40 and 60 DAS, respectively. Better weed control at early stage of the crop due to pre-emergence application of alachlor and suppression of weeds thereafter by shade effect of standing daincha and mulch provided by shed crop residue from killed daincha under brown manuring might have favoured the crop to markedly increase in all growth attributes of maize. This is in agreement with the findings of Rao and Nagamani (2007). According to Venkatalaksmi and Balasubramanian (2009), intercropping with sunhemp had significant influence on plant height and dry matter production. It was attributed to increased availability of mineralized nutrients and higher uptake of mineralized N by the crop from the organic matter containing residue.

The recommended practice of PE alachlor @ 1.0 kg ha^{-1} followed by mechanical weeding by hand hoe at 35 DAS (T2) was effective next to the above treatments in increasing the growth attributes in all the stages of crop (Table 3). Though, application of pre emergence alachlor and mechanical weeding given in this treatment, maize as sole crop in wider spacing might have favoured the weed growth as compared to the treatments T6 and T5 in these daincha was raised as intercrop wherein suppression of weeds could be more due to more shade effect. This might be attributed to substantial decrease in growth attributes in the recommended practice T2.

The farmer's practice of mechanical weeding by hand hoe on 20 and 35 DAS (T1) has occupied 4th rank in influencing the growth attributes at 40 and 60 DAS. All the growth attributes were found to be statistically declined in unweeded check (T7) over rest of the treatments (Table 3). Profused weed growth with high depletion of nutrient by weeds during crop weed competition period in unweeded check could have greatly affected the manufacturing of photosynthesis in maize crop and hence such decline. Bonilla (1984) reported that leaf area index was an accurate indicator for crop weed competition.

It could be concluded from the results that PE alachlor 1.0 kg ha^{-1} + brown manuring was the best treatment to reduce weed dry weight and to achieve more available soil moisture content and increased growth attributes in irrigated maize. Application of PE alachlor 1.0 kg ha^{-1} + daincha as intercrop with *in-situ* incorporation on 35 DAS was the next best treatment for controlling the weed dry weight and to increase the available soil moisture and growth attributes in irrigated maize.

References

Anonymous. 2008. Annual Report of 2007-08. Directorate of Maize Research. ICAR, New Delhi.

Bonilla, J.S. 1984. Critical period of competition between maize and weeds. *Centro Agricola.,* **11**(3): 37-44.

Rao, A.N. and Nagamani, A. 2007. Available technologies and future research challenges for managing weeds in dry-seeded rice in India. *In Proc. of the 21st Asian Pacific Weed Sci. Society Conf. October 2-6, 2007*, Colombo, Sri Lanka.pp.391-400.

Samar Singh, Ladha, J.K., Gupta, R.K., Bhushan, L., Rao, A.N., Shiva Prasad, B. and Singh, P. 2007. Evaluation of mulching, intercropping with *Sesbania* and herbicide use for weed management in dry-seeded rice (*Oryza sativa*).*Crop Prot***., 26**: 518-524.

Sharma, A.R., Ratan Singh, Dhyani, S.K. and Dube, R.K. 2010. Tillage and legume mulching effects on moisture conservation and productivity of rainfed maize (*Zea mays*) – wheat (*Triticum aestivum*) cropping system. *Indian J. Agron.,* **55** (4): 245-252.

Tanwar, S.P.S., Singh, A.K. and Joshi, N.L. 2010.Changing environment and sustained crop production: A cha llenge for agronomy. *J. arid legume.,* **7** (2)**:** 91-100.

Venkatalakshmi, K. and Balasusbramanian, A. 2009. Supplemental irrigation, green manuring and nitrogen levels on growth components, dry- matter accumulation and physiological parameters in dryland maize. *Madras Agric. J.,* **96** (7-12): 370-373.

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