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INFLUENCE OF WEEDS AS ORGANIC MATERIALS ON NUTRIENT AVAILABILITY, CONTENT AND UPTAKE OF SECONDARY NUTRIENTS BY RICE

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ABSTRACT
Chemical fertilizers which one of the most basic needs of present day agriculture has shown marked cost escalation in recent years. On the other hand, many waste plants are growing at providing abundant biomass which can be exploited for soil improvement and economic crop production. Among these parthenium (*Parthenium hysterophorus*) and chromolaena (*Chromolaena odorata*) are fast growing which come up in abundance in fallow lands, road sides, gomal lands. Besides having high content of N and P and secondary and micronutrients and they have succulent biomass and could be used to help substantially in N and P economy of crops if incorporated in the soil. To evaluate the effect of recommended dose of fertilizers and parthenium and chromolaena as green manures and their compost incorporation on paddy yield and its nutrition, a experiment was conducted at farmers filed, Aldur village, Mudigere, Chickmagalur district, Karnataka state. Exchangeable calcium and magnesium in soil varied significantly at different stages of crop growth due to application of organics and inorganics. Highest content of exchangeable calcium and magnesium was noticed in T_{10}: RDF + chromolaena compost @ 7.5 t/ha as compared to T_2: RDF alone. Calcium and magnesium content in rice straw was significantly increased due to different treatments. The highest calcium and magnesium content was recorded in the treatment that received RDF + Chromolaena compost @ 7.5 t/ha (T_{10}). At tillering stage, the highest sulphur was noticed in soil in treatment that received RDF + chromolaena compost @ 7.5 tonnes/ha. By and large nutrient uptake pattern was followed the same trend as observed in grain and straw yield. The data pertaining to calcium, magnesium and sulphur uptake by rice and straw and grain varied significantly due to different treatments

KEY WORDS: Parthenium, chromolaena, compost, calcium, magnesium, sulphur.

INTRODUCTION
Continuous addition of chemical fertilizers poses problems like toxicity due to high amount of salts as residue fertilizers, deterioration of the physic-chemical properties of soil, impairing the aeration and soil-water-plant relationship resulting in decreased. Organic manures ameliorate the problem which, helps in increasing the adsorptive power of soil for cations and anions. The adsorbed nutrient ions are released slowly for the benefit of crop during entire growth period. It also improves the organic carbon status and available nutrients. Conjunctive use of organic materials with chemical fertilizers is essential, which not only sustains higher levels of productivity but also improves soil health. Quantity and quality of organic materials available for the soil incorporation are two deciding factors, to put organics into use. India is endowed with plethora of plant species occurring naturally as wild plants in and around farm lands. Most of these plants are highly useful as sources of biomass for recycling in crop production systems. Many such plants like Eupatorium, Parthenium, Water hyacinth, Ipomoea, Lantana, and Cassia species have spread menacingly threatening agriculture and environment. Chromolaena (*Chromolaena odorata*) is a perennial weed belonging to Asteraceae is widely found in all unused vacant lands of high rainfall areas of Western Ghats and Coastal Zones of Karnataka. Parthenium (*Parthenium hysterophorus*) belonging to Asteraceae has occupied larger areas except seashore and can tolerate drought condition. Keeping in this view field experiment was conducted to know influence of parthenium and chromolaena as green manuring and their compost.

MATERIALS AND METHODS
A field experiment was conducted at farmer's field at Aldur village, Chickmagalur taluk, Chickmagalore district, Karnataka state under rain fed condition. The soil of the experimental site is Typic Paleustalf. The initial property of the experimental site was: pH 5.38, EC 0.04 dSm^{-1}, total organic carbon 0.98%, NH_4^+-N 61.10 mg kg^{-1}, NO_3- N 10.0 mg kg^{-1}, Brays-P 6.71 mg kg^{-1} and NH_4OAc-K 68.91 mg kg^{-1}. The carbon per cent of parthenium and chromolaena were 39.30 and 38.32 respectively. The ten treatments with three replication in a randomized block design are as follows:

Design	:	Randomized block design
No. of treatments	:	10
No. of replications	:	3
Crop	:	Rice
Variety	:	Sharavathi
Recommended dose of fertilizer (RDF)	:	100: 50: 50 (N: P_2O_5: K_2O)
Plot size	:	6 m x 6 m

Treatments

T_1	:	Control
T_2`	:	Recommended dose of fertilizer (RDF)
T_3	:	RDF + Parthenium as green manure @ 5.0 t/ha (RDF + PG1)
T_4	:	RDF + Parthenium as green manure @ 7.5 t/ha (RDF + PG2)
T_5	:	RDF + Parthenium compost @ 5.0 t/ha (RDF + PC1)
T_6	:	RDF + Parthenium compost @ 7.5 t/ha (RDF + PC2)
T_7	:	RDF + Chromolaena as green manure @ 5.0 t/ha (RDF + CG1)
T_8	:	RDF + Chromolaena as green manure @ 7.5 t/ha (RDF + CG1)
T_9	:	RDF + Chromolaena compost @ 5.0 t/ha (RDF + CC1)
T_{10}	:	RDF + Chromolaena compost @ 7.5 t/ha (RDF + CC2)

Calculated quantities of compost and green manures were applied to the plots as per the treatments and were thoroughly mixed with the soil. Fertilizers were applied as per details of treatments through fertilizers *viz*., urea, diammonium phosphate and muriate of potash to supply N, P_2O_5 and K_2O. In all the fertilizer treatments, entire P_2O_5 and K_2O were applied basally. Nitrogen was applied in two splits 50 per cent at planting and 50 per cent at panicle initiation stage. Paddy seedlings were transplanted, the crop was irrigated.

Soil samples and plant samples were collected at tillering, panicle initiation and harvest stages. Plant samples were air dried and later oven dried at 70 0C and ground to fine powder using stainless steel willey mill and analysed for Ca, Mg and S nutrients by adopting standard procedures. Soil samples were air dried in shade, ground with wooden pestle and mortar and passed through 2 mm sieve and analyzed for different properties. Exchngeable Ca and Mg and available S were determined as per the standard procedures (Jackson, 1973). After the determination of nutrient concentration in the grain and straw separately, then the uptake of grain and straw was computed using this formula

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%)}}{100} \times \text{dry weight (kg/ha)}$$

Data was analysed statistically to test significances and the treatments are tested at five per cent level of significance. The analysis was carried by the methodology as described by Sundara Raj *et al*. (1972).

RESULTS AND DISCUSSION

Initial physico-chemical properties of the soils

Soil selected for the conduct of experiments had diverse physico-chemical properties (Table 1). Soil has more of silt and clay (14.10 and 10.50 % respectively) and it is moderately acidic with a pH value of 5.38. The organic carbon content was 0.98 per, total nitrogen content (0.19 %), Brays extractable phosphorus (6.71 mg kg^{-1} soil). Secondary nutrients like Exchangeable Ca and Mg are 1.65 and 0.93 (c mol (p^+) kg^{-1}) respectively. Available sulphur (2.89 mg kg^{-1} soil), DTPA extractable Fe, Mn, Zn and Cu are 78.32, 2.87, 1.56 and 2.01 mg kg^{-1} respectively.

Chemical composition of organic materials

Data on chemical composition of organic materials used in the experiments are presented in Table 2. Highest carbon content was noticed in chromolaena (39.30 %) followed by cow dung (40.70 %) and least was in parthenium (38.32 %). Maximum N was noticed in cow dung (2.90 %) followed by chromolaena (1.9 %) and parthenium (1.6 %). Phosphorus content ranged from 0.12 to 0.69 per cent; lowest was in cow dung and highest was in chromolaena. Maximum K content was noticed in cow dung (1.71 %) followed by chromolaena (1.08 %) and parthenium (0.98 %). The calcium content was highest in chromolaena (0.62 %) followed by parthenium (0.40 %) and cow dung (1.27 %). The magnesium content was highest in parthenium (1.04 %) and least in cow dung (0.49 %), the sulphur content was noticed higher in cow dung (0.51 %) and was least in parthenium (0.29 %).

TABLE 1. Physico – chemical properties of the soil experimental site

a). Physical properties	
Coarse sand (%)	49.80
Fine sand (%)	25.60
Silt (%)	14.10
Clay (%)	10.50
Texture	Loamy Sand
Taxonomic classification	Typic Paleustalf
b). Chemical Properties	
pH (1:2.5 in distilled water)	5.38
(1:2.5 in 0.1 M $CaCl_2$)	4.50
Electrical conductivity (dSm^{-1})	0.04
Total organic carbon (%)	0.98
Total Nitrogen (%)	0.19
NH_4^+-N (mg kg^{-1})	61.10
NO_3^- -N (mg kg^{-1})	10.00
Brays-P (mg kg^{-1})	6.71
NH_4OAc -K(mg kg^{-1})	68.91
0.15% $CaCl_2$-S (mg kg^{-1})	2.89
NH_4OAc-Ca (c mol (p^+) kg^{-1})	1.65
NH_4OAc-Mg (c mol (p^+) kg^{-1})	0.93
DTPA-Fe (mg kg^{-1})	78.32
DTPA-Mn (mg kg^{-1})	2.87
DTPA-Cu (mg kg^{-1})	1.56
DTPA-Zn (mg kg^{-1})	2.01

Higher amount of iron and zinc was noticed in parthenium and higher amount of manganese and copper were noticed in chromolaena. The C: N ratio showed wide variation among organic materials. It ranged from 14.03 (cow dung) to 20.68 (chromolaena). The C: P and C: S ratio also showed wide variations. Narrow C: P ratio was noticed in cow dung (40.70) where as narrow C: S ratio was recorded in cow dung (66.07). In parthenium widest C: P and C: S ratio of 60.82 and 108.0 was observed respectively.

The organic carbon content was highest in chromolaena compost (20.47%) compared to parthenium compost (19.52%). Total N was higher in chromolaena compost (1.32 per cent) than in parthenium compost (0.94 per cent). The C: N ratio of parthenium compost and chromolaena compost composts were 28.76 and of chromolaena compost 15.50 respectively. The P content of parthenium compost was 1.03 per cent and that of chromolaena compost was 1.93 per cent. The K content of parthenium compost was 1.46 per cent and that of chromolaena compost was 1.89 per cent. The calcium, magnesium and sulphur content of parthenium compost were 1.22, 1.19, 0.34 and that of chromolaena compost was 1.76, 1.54 and 0.32 per cent respectively. The iron, manganese, copper and zinc contents in the compost recorded were 71.00, 10.49, 1.64, 5.40 mg kg^{-1} in parthenium compost, whereas in chromolaena compost 51.90, 12.20, 1.71, 3.85 mg kg^{-1} respectively.

Nutrient status

Exchangeable calcium and magnesium in soil is presented in Table.3 and values varied significantly at different stages of crop growth due to application of organics and inorganics. Highest content of exchangeable calcium and magnesium was noticed in T_{10}: RDF + chromolaena compost @ 7.5 t/ha as compared to T_2: RDF alone. The reason for reduction of exchangeable calcium and magnesium content of soil in the chemical fertilized plots could be due to removal of calcium and magnesium by the crops was greater than that was added from external sources to the soil.

TABLE 2. Chemical composition of the organic materials

Parameters	Chromolaena	Parthenium	Chromolaena compost	Parthenium compost
Carbon (C) [a]	39.30	38.32	20.47	19.52
Nitrogen (N) [a]	1.90	1.60	1.32	0.94
Phosphorus (P)[a]	0.69	0.63	1.93	1.03
Potassium (K)[a]	1.08	0.98	1.89	1.46
Calcium (Ca)[a]	0.62	0.40	1.76	1.22
Magnesium (Mg)[a]	0.90	1.04	1.54	1.19
Sulphur (S)[a]	0.36	0.29	0.32	0.34
Iron (Fe)[b]	3920	6938	5190	7100
Manganese (Mn)[b]	414	329	620	549
Zinc (Zn)[b]	84.6	104.60	385	540
Copper (Cu)[b]	114.6	112.0	171	164
C:N ratio	20.68	23.95	15.50	20.76
C:P ratio	56.96	60.82	10.61	18.95
C:S ratio	109.16	132.13	63.97	57.41

a = g $100g^{-1}$
b = mg kg^{-1}

Increased content of exchangeable calcium and magnesium in T_{10}: RDF + chromolaena compost @ 7.5 t/ha was attributed to release of calcium and magnesium during mineralization of added organic matter and also retention of Ca^{2+} and Mg^{2+} by organic colloids. This is in agreement with the findings of Prasad (1992). The increase in soil solution's concentration of calcium and magnesium in the organic matter treated plots mainly attributed to dissolution of iron and manganese oxides and hydrates under highly reduced conditions and subsequent displacement of calcium and magnesium content of soil was higher at initial stage of the crop and declined at later stages. This may be due to uptake of calcium and magnesium by growing plants as reported by Prakash and Badrinath (1994).

A significant difference in the available sulphur status of soil was observed (Table .3). At tillering stage, the highest sulphur was noticed in soil in treatment that received RDF + chromolaena compost @ 7.5 tonnes/ha. This might be due to mineralization of sulphur from organic matter (Ponnamperuma, 1972). The available sulphur content in soil was higher in initial stages of crop but decline at the later stages. This may be due to the high uptake of S by the growing plants lead to lowest available sulphur content at harvest stage (Darshan Singh *et al.,* 1976).

CONTENT

Calcium and magnesium content in rice straw was significantly increased due to different treatments (Table 4). The highest calcium and magnesium content was recorded in the treatment that received RDF + Chromolaena compost @ 7.5 t/ha (T_{10}). The increase in the calcium content in the rice might be due to release of more calcium into soil form exchangeable site. Prakash and Badrinath (1994) also observed an increase in concentration of calcium and magnesium by rice with increase in soil phosphorus content. Increased magnesium may be due to incorporation of organic matter along with chemical fertilizers that released the nutrients to soil from exchangeable complex. Chellamuthu *et al,* (1989) found that combined application of organics with fertilizers resulted in the highest uptake and highest concentration of calcium and magnesium in the crop.

The sulphur content of rice straw was 0.09, 0.09 and 0.07 per cent at tillering, panicle initiation and harvest stages respectively and grain recorded 0.04 per cent in control. At tillering stage, higher nutrient content was noticed and decreased in later stages due to higher dry matter production and adsorption and mobilization of nutrients during developing grains. Lal and Mahapatra (1975) reported that nutrient content in plants decreased with increased with increased age of crop growth.

TABLE 3. Influence of recommended dose of fertilizers in combination with various levels of organic manures on Exchangeable calcium and magnesium and available sulphur status of soil at different stages of rice

Treatments	Calcium (c mol (P^+) kg)			Magnesium (c mol (P^+) kg)			Available Sulphur (mg kg^{-1})		
	Tillering stage	Panicle initiation stage	Harvest stage	Tillering stage	Panicle initiation stage	Harvest stage	Tillering stage	Panicle initiation stage	Harvest stage
T1: Control	2.01	1.72	1.50	1.26	1.14	0.90	3.38	3.06	2.71
T2: RDF	1.98	1.63	1.41	1.23	1.17	0.90	3.53	3.37	2.73
T3: RDF+PG 1	2.23	1.98	1.71	1.28	1.18	0.91	3.75	3.54	2.81
T4: RDF+PG 2	2.28	2.06	1.73	1.32	1.21	0.93	4.45	4.06	2.84
T5: RDF+PC 1	2.36	2.09	1.75	1.39	1.28	0.95	4.76	4.46	2.93
T6: RDF+PC 2	2.48	2.14	1.81	1.42	1.31	0.98	4.79	4.56	3.00
T7: RDF+CG 1	2.34	2.09	1.73	1.33	1.20	0.92	4.53	4.38	2.92
T8: RDF+CG 2	2.45	2.11	1.76	1.35	1.29	0.96	4.38	4.06	2.99
T9: RDF+CC 1	2.57	2.21	1.80	1.39	1.35	0.99	4.49	4.14	3.06
T10: RDF+CC 2	2.49	2.38	1.99	1.45	1.38	1.06	4.85	4.65	3.12
SEm ±	0.12	0.11	0.11	0.11	0.10	0.11	0.03	0.05	0.01
LSD (P =0.05)	0.32	0.30	0.29	0.26	0.31	0.33	0.07	0.14	0.04

TABLE 4. Calcium, magnesium and sulphur nutrient content (%) in straw at different stages of rice as influenced by recommended dose of fertilizers in combination with various levels of organic manures

Treatments	Calcium			Magnesium			Sulphur		
	Tillering stage	Panicle initiation stage	Harvest stage	Tillering stage	Panicle initiation stage	Harvest stage	Tillering stage	Panicle initiation stage	Harvest stage
T1: Control	0.68	0.64	0.63	0.29	0.26	0.23	0.09	0.09	0.07
T2: RDF	0.70	0.65	0.64	0.27	0.27	0.25	0.09	0.09	0.07
T3: RDF+PG 1	0.73	0.68	0.66	0.29	0.28	0.27	0.11	0.10	0.08
T4: RDF+PG 2	0.75	0.71	0.68	0.34	0.33	0.30	0.13	0.12	0.11
T5: RDF+PC 1	0.75	0.73	0.69	0.34	0.31	0.28	0.15	0.14	0.12
T6: RDF+PC 2	0.78	0.78	0.74	0.36	0.34	0.31	0.18	0.16	0.13
T7: RDF+CG 1	0.76	0.73	0.68	0.35	0.33	0.30	0.13	0.11	0.09
T8: RDF+CG 2	0.79	0.75	0.71	0.39	0.36	0.33	0.16	0.15	0.13
T9: RDF+CC 1	0.79	0.77	0.72	0.39	0.37	0.32	0.18	0.17	0.15
T10: RDF+CC 2	0.83	0.81	0.77	0.41	0.39	0.37	0.21	0.19	0.17
SEm ±	0.012	0.011	0.012	0.012	0.013	0.013	0.006	0.005	0.008
LSD (P =0.05)	0.036	0.34	0.038	0.036	0.040	0.038	0.018	0.015	0.024

CONTENT

Calcium and magnesium content in rice straw was significantly increased due to different treatments (Table 4).The highest calcium and magnesium content was recorded in the treatment that received RDF + Chromolaena compost @ 7.5 t/ha (T_{10}). The increase in the calcium content in the rice might be due to release of more calcium into soil form exchangeable site. Prakash and Badrinath (1994) also observed an increase in concentration of calcium and magnesium by rice with increase in soil phosphorus content. Increased magnesium may be due to incorporation of organic matter along with chemical fertilizers that released the nutrients to soil from exchangeable complex. Chellamuthu *et al*, (1989) found that combined application of organics with fertilizers resulted in the highest uptake and highest concentration of calcium and magnesium in the crop. The sulphur content of rice straw was 0.09, 0.09 and 0.07 per cent at tillering, panicle initiation and harvest stages respectively and grain recorded 0.04 per cent in control. At tillering stage, higher nutrient content was noticed and decreased in later stages due to higher dry matter production and adsorption and mobilization of nutrients during developing grains. Lal and Mahappatra (1975) reported that nutrient content in plants decreased with increased with increased age of crop growth.

TABLE 5. Influence of recommended dose of fertilizers in combination with various levels of organic manures on uptake of calcium and magnesium and sulphur (kg ha^{-1}) by rice grain and straw

Treatments	Grain			Straw		
	Calcium	Magnesium	Sulphur	Calcium	Magnesium	Sulphur
T1: Control	0.09	0.05	0.01	0.20	0.06	0.02
T2: RDF	0.16	0.08	0.02	0.30	0.10	0.03
T3: RDF+PG 1	0.18	0.10	0.03	0.32	0.12	0.04
T4: RDF+PG 2	0.21	0.12	0.03	0.35	0.14	0.06
T5: RDF+PC 1	0.20	0.13	0.03	0.37	0.15	0.06
T6: RDF+PC 2	0.23	0.16	0.04	0.41	0.18	0.07
T7: RDF+CG 1	0.21	0.12	0.03	0.37	0.14	0.05
T8: RDF+CG 2	0.22	0.14	0.03	0.38	0.16	0.07
T9: RDF+CC 1	0.23	0.14	0.04	0.39	0.16	0.08
T10: RDF+CC 2	0.26	0.18	0.05	0.43	0.20	0.09
SEm ±	0.012	0.013	0.008	0.011	0.013	0.008
LSD (P =0.05)	0.038	0.038	0.024	0.034	0.037	0.025

UPTAKE

Uptake of nutrients by rice grain and straw has been worked as product of yield of grain and straw and their composition for respective elements. By and large nutrient uptake pattern was followed the same trend as observed in grain and straw yield. The data pertaining to calcium, magnesium and sulphur uptake by rice and straw and grain varied significantly due to different treatments (Table. 5). Treatment that received RDF + Chromolaena compost @ 7.5 t/ha (T_{10}) recorded highest uptake of secondary nutrients. Increased uptake might be due to higher availability of the plant nutrients supplied by organic matter.

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