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Correlation coefficient analysis in Java citronella (*Cymbopogon winterianus*)

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Abstract

Field study was carried out during *kharif* 2009-10 and 2010-11 at Nagarjun Medicinal and Aromatic Plants Garden, Dr. PDKV, Akola (M.S.), India. The fertility status of the soil was moderate in organic carbon, low in available nitrogen and available phosphorus and very high in available potassium while the soil micronutrient contents (Zn, Fe, Mn, Cu) were above the critical level. Experiment comprised of thirteen treatments replicated thrice in randomized block design, involving control (no fertilizer/manure), 5 t FYM ha⁻¹, 10 t FYM ha⁻¹, 80:20:40 kg NPK ha⁻¹, 100:30:60 kg NPK ha⁻¹, 140:40:80 kg NPK ha⁻¹, 5 t FYM + 80:20:40 kg NPK ha⁻¹, 5 t FYM + 100:30:60 kg NPK ha⁻¹, 5 t FYM + 140:40:80 kg NPK ha⁻¹, 10 t FYM + 80:20:40 kg NPK ha⁻¹, 10 t FYM + 100:30:60 kg NPK ha⁻¹, 10 t FYM + 140:40:80 kg NPK ha⁻¹ and 100 kg N through FYM (based on FYM analysis).

Correlation coefficient worked out for parameters viz., plant height, number of tillers, dry matter yield, oil content and total uptake of nutrients (N, P, K, S, Fe, Mn, Zn, Cu) with herbage yield observed to be highly significant for almost all the parameters studied, indicating the strong association with herbage yield. Similarly, the path coefficient analysis was also being performed and the data revealed that Fe uptake exhibited highest positive direct effect (21.398) on herbage yield of Java citronella followed by Cu uptake and K uptake, whereas Mn uptake exhibited the second highest direct effect (-21.171) but the magnitude is in negative direction, indicating that its contribution in herbage yield is through the indirect effect exerted via Fe uptake, Cu uptake, K uptake and P uptake.

From the results, it can be concluded that the Fe uptake has expressed the highest positive influence on herbage yield of Java citronella directly as well as indirectly via other parameters.

Keywords: Java citronella, correlation coefficient and path coefficient analysis

Introduction

Cymbopogon winterianus commonly known as Java citronella belongs to Graminae family and is originally from Sri Lanka was selected for the study. It is a tall perennial tufted aromatic grass with superficial fibrous roots. It is basically, a tropical plant mainly cultivated in Indonesia, Sri Lanka, China and India. In India, major producing area is the tea gardens in Assam and to a limited extent in states like U.P., Maharashtra, Karnataka, Gujarat, Manipur, Meghalaya, Tamil Nadu, Nagaland, Uttaranchal, A.P. and Tripura where it is commercially cultivated and distilled for its oil (Shiva *et al.*, 2002) [6].

Java citronella has a world production of 1600 tons per year and out of which 500 tones is produced in India on 9000 ha area. India stands 3rd position in essential oil production in the world. In Maharashtra the area is around 320 ha with the production of 25 ton of oil per annum. The area in Vidharbha under this crop is 56.4 ha and the major districts cultivated this crop are Nagpur, Yavatmal, Akola, Wardha, Chandrapur and Amravati. There is a large scope to cultivate this Aromatic crop. The market demand up to the year 2025 in the India is estimated to 3200 ha and 66000 ha in World. In Maharashtra the cultivation of Java citronella is proposed to the extent of 1600 ha with the production of oil around 480 tons. Presently, the oil and value added products of the oil has gaining price of ` 325-350 kg⁻¹ and hydroxyl citronellol has ` 1150 kg⁻¹ with the estimated demand of 120-130 tons per year (Anonymous, 2004) [1].

The oil is used mostly in perfumery, both directly and indirectly in soaps, soap flakes, cosmetics, detergents, agarbatties, insecticides, *etc.* are often perfumed exclusively with this oil. Small quantity of citronellal is used in perfumery as an aromatic chemical. However, the greatest importance of citronellal lies in its role as a starting material for further derivatives.

It is good mosquito repellent. The leftover of the citronella grass has been recommended to be utilized as source of raw material for cellulose pulp and paper production by using sulphate, sulphite and cold caustic soda.

Since, many of the aromatic plants are perennial in nature the nutrient depletion is a cause of concern for sustaining the yields over a long period of time. To understand the pattern of nutrient removal by some important aromatic crops grown on red soils, a series of analytical studies were conducted and it was noticed that, substantial quantities of nutrient elements are depleted by aromatic crops (Prakasa Rao, 1992) [4]. Some recent studies have also reported the emergence of potassium deficiency in soil which potentially influenced the quality of essentials (Prakasa Rao *et al.*, 1996) [5]. Moreover, such deficiencies certainly retard crop growth with low productivity.

At present no information is available on nutrient management of these grasses under agroclimatic condition of Vidarbha region. Being a perennial crop periodic replenishment of nutrients is essential to keep the plantation viable for 4-5 years. Therefore, the requirement of nutrients should be worked out with prime consideration to soil test values and biological yield potential for specific locations. The optimum dose of organic manure and fertilizer for highest herbage and oil yield is to be worked out. Therefore, keeping in view of above facts the present investigation was carried out.

Material and Methods

Study site and Treatment Features

The experiment was conducted during *Kharif* seasons of 2009-10 and 2010-11 at Nagarjun Medicinal Plants Garden, Dr. PDKV, Akola (latitude of 22° 41' N and longitude of 77° 02' E with an altitude 307.41 meters). The climate of experimental site is semi-arid and subtropical with extreme conditions having hot and dry summer and cold winter, where maximum temperature goes up to 42.6 °C during summer and minimum as low as 10.3 °C during winter. The annual average rainfall of area is 764.7 mm. The soil of the experimental field was medium black, Smectitic, clay loam in texture and classified as *Typic Haplustept* which comes under the soil order Inceptisol. The initial soil analysis indicated that, the soil was calcareous in nature and moderately alkaline in reaction. In case of physical properties the soil was low in hydraulic conductivity and available water capacity. The fertility status of the soil was moderate in organic carbon, low in available nitrogen and available phosphorus and very high in available potassium while the soil micronutrient contents (Zn, Fe, Mn, Cu) were above the critical level. The experiment was laid out with randomized block design having three replication comprising of 13 treatments, *viz* Control (no fertilizer/manure), 5 t FYM ha⁻¹, 10 t FYM ha⁻¹, 80:20:40 kg NPK ha⁻¹, 100:30:60 kg NPK ha⁻¹, 140:40:80 kg NPK ha⁻¹, 5 t FYM + 80:20:40 kg NPK ha⁻¹, 5 t FYM + 100:30:60 kg NPK ha⁻¹, 5 t FYM + 140:40:80 kg NPK ha⁻¹, 10 t FYM + 80:20:40 kg NPK ha⁻¹, 10 t FYM + 100:30:60 kg NPK ha⁻¹, 10 t FYM + 140:40:80 kg NPK ha⁻¹ and 100 kg N through FYM (based on FYM analysis). Treatment wise FYM was added on dry weight basis before planting of Java citronella during 2009-10

contain 0.67% N, 0.22% P and 0.49% K and in the month of April 2010 contain 0.64% N, 0.20% P and 0.51% K after 3rd cutting as per treatments. Treatment wise Nitrogen, Phosphorus and Potassium doses were applied in both the years (2009-10 and 2010-11). Nitrogen was applied through urea in three split doses as per treatment after each cutting. Full dose of Phosphorus and Potassium was applied as a basal dose at the time of planting through single super phosphate and muriate of potash as per the treatments.

Sowing and Harvesting

The study started on 7th July 2009, when Java citronella 'Bio-13' plantlets were planted (rooted slips @ 16666 slips ha⁻¹). A spacing of 90 x 60 cm was maintained between each planting. The plantlets were irrigated soon after transplantation and thereafter as and when needed during the experiment. Java citronella was harvested by cutting the leaf blade at its base, *i.e.*, approximately 10-12 cm above the ground. During the two seasons of the study, the crop was harvested 6 times.

Statistical analysis

Standard method of analysis known as 'Analysis of Variance' was applied for the statistical analysis. The critical difference (C.D.) was worked out at 5% level of significance for the treatment comparison wherever the 'F' test recorded significant. Pooled analysis of two years data was carried out as per procedure described by Gomez and Gomez (1984) [2].

Path analysis of selected parameters (*viz.*, plant height, number of tillers, dry matter yield, oil content and total uptake of nutrients) was carried out to find out the direct and indirect effect on the herbage yield as per the standard procedure (Panse and Sukhatme, 1961) [3].

Results and Discussion

Correlation studies

Correlation coefficient was worked out for parameters *viz.*, plant height, number of tillers, dry matter yield, oil content and total uptake of nutrients (N, P, K, S, Fe, Mn, Zn, Cu) with herbage yield (t ha⁻¹) and the data is presented in table 1. It is observed that the correlation coefficient was highly significant for all most all the parameters under study indicating the strong association with herbage yield.

Similarly, the path coefficient analysis was also being performed and the data revealed that Fe uptake exhibited highest positive direct effect (21.398) on herbage yield followed by Cu uptake and K uptake, whereas Mn uptake exhibited the second highest direct effect (-21.171) but the magnitude is in negative direction, indicating that its contribution in herbage yield is through the indirect effect exerted via Fe uptake, Cu uptake, K uptake and P uptake.

Overall the Fe uptake has expressed the highest influence on herbage yield of Java citronella directly as well as indirectly via other parameters.

Conclusions

From the results, it can be concluded that the Fe uptake has expressed the highest positive influence on herbage yield of Java citronella directly as well as indirectly via other parameters.

Table 1: Correlation matrix of 12 parameters with total herbage yield of Java citronella (direct and indirect effect on main and diagonal)

Parameters	r ² value	Plant height	No. of tillers	Dry matter yield	Oil content	N uptake	P uptake	K uptake	S uptake	Fe uptake	Mn uptake	Zn uptake	Cu uptake
Plant height	0.979**	1.119	-0.066	-3.095	0.476	-1.836	1.459	1.534	-2.076	20.953	-20.732	-2.483	5.610
No. of tillers	0.963**	1.033	0.071	-2.967	0.535	-1.785	1.428	1.512	-2.161	20.615	-20.398	-2.453	5.548
Dry matter yield	0.891**	1.108	0.068	-3.125	0.507	-1.852	1.477	1.551	-2.131	21.285	-21.059	-2.528	5.709
Oil content	0.995**	0.904	0.065	-2.686	0.590	-1.651	1.305	1.413	-2.154	19.322	-19.119	-2.322	5.249
N uptake	0.901**	1.105	0.069	-3.112	0.524	-1.859	1.478	1.563	-2.174	21.342	-21.116	-2.538	5.732
P uptake	0.997**	1.103	0.069	-3.119	0.520	-1.856	1.480	1.559	-2.165	21.362	-21.136	-2.539	5.736
K uptake	0.998**	1.097	0.069	-3.095	0.532	-1.856	1.474	1.565	-2.197	21.326	-21.100	-2.538	5.734
S uptake	0.996**	1.038	0.069	-2.975	0.567	-1.806	1.432	1.537	-2.238	20.919	-20.699	-2.498	5.645
Fe uptake	0.974**	1.096	0.069	-3.108	0.532	-1.854	1.477	1.560	-2.188	21.398	-21.171	-2.546	5.750
Mn uptake	0.998**	1.096	0.069	-3.108	0.532	-1.854	1.477	1.560	-1.188	21.398	-21.171	-2.546	5.750
Zn uptake	0.998**	1.091	0.69	-3.102	0.538	-1.853	1.476	1.560	-2.195	21.394	-21.168	-2.546	5.752
Cu uptake	0.999**	1.091	0.069	-3.102	0.538	-1.853	1.476	1.561	-2.196	21.393	-21.167	-2.546	5.751

* indicates significant at 5% and ** at 1%, respectively

Residual effect = 0.1943

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