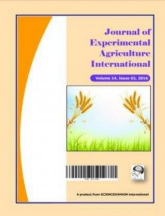

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Yield Attributing Characters and Biomass Accumulation of Safed Musli as Influenced by FYM and Fly Ash Application under Inceptisol

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The field experiment was conducted during 2013-2014 at Nagarjuna Medicinal Plants Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S.) There were three levels of FYM and four levels of fly ash with three replications in FRBD on Inceptisol with a view to study the effect of FYM and fly ash application on yield, quality and nutrient uptake of safed musli. As the physiological maturity of the crop begins at 85-90 days after sowing (DAS) the growth observations e.g. number of leaves, leaf area were recorded at 30, 60 and 90 days after sowing. The number of leaves were successively increased with each growth stage upto 60 days Significantly highest leaf area was recorded with the application of 20 t FYM ha^{-1} (M_2) .Significantly highest leaf area (29.56 cm^2) was recorded at 60 DAP with the application of 15 t fly ash ha^{-1} which was at par with 10 t fly ash ha^{-1} (F2) and 5 t fly ash ha^{-1} (F1). Significantly highest dry matter accumulation was recorded with the

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application of 20 t FYM ha^{-1}, however, it was at par with 10 t FYM ha^{-1}. The highest biomass accumulation was observed with 15 t fly ash ha^{-1} (F3) which was at par with 10 t fly ash ha^{-1} (F2) and 5 t fly ash ha^{-1} (F1). The thermal industrial waste like fly ash showed a promising option for nutrient management in medicinal crop plant like safed musli which can substitute to some extent costly chemical fertilizer and improve the qualitative value of safed musli.

Key word: FYM; fly ash; Safed musli; DAP (Days after planting).

1. INTRODUCTION

Medicinal plants play an important role in the development of potent therapeutic agents. Herbal drugs from the backbone of the invaluable traditional medicinal practices. Recently interest in medicinal plant research has increased all over the world. It has been reported that medicinal plants used in various traditional systems have immune potential against various diseases.

Safed musli (*Chlorophytum borivililanum*) is an important medicinal perennial herb, belongs to family Liliaceae, widely distributed in India and found in hilly regions of Himalay, Satpuda, Vindhay, Aravuli and in hilly area of Bihar and Assam. It is also found in the part of Rajasthan and Gujarat. In Maharashtra, particularly, in Vidarbha, safed musli found widely in the forest of Melghat, Chikhaldara and Satpuda hills nearby Akot (Akola) and Jalgaon Jamod (Buldhana). This species has low rate of regeneration due to shy flowering and poor setting of viable seed. It may thus become rare and may be lost from the habitat if the large scale collection in forest continues at the present rate [1]. The fasciculated root of this herb has great medicinal values mainly due to its saponin content and is used extensively in Ayurvedic medicines. The roots also having aphrodisiac properties and therefore it is an important ingredient of herbal tonic to cure general debility and male sterility [2].

Bordia et al. [3] reported that the major constituents of safed musli are carbohydrates (42%), protein (8-9%), root fibres (3-4%) and saponin (2-17%). Presently, the root fetches an attractive price in the market, which is mainly determined by the size and colour of the roots and its physical appearance. For obtaining good quality roots, the plant growth medium should be porous with optimum fertility status. In that context; the application of FYM and fly ash might be best source for improving physical properties of soil as well as provide nutrients to the crop.

Fly ash occurs as very fine particles, having an average diameter of less than 10 micron, low to medium bulk density, high surface area and very light texture. The chemical composition of fly ash varies depending on the quality of coal used and the operating conditions of the thermal power stations. Approximately 95 percent to 99 percent of fly ash consists of sodium, phosphorous, potassium and sulphur, and the remaining is composed of trace elements. Thus, fly ash practically consists of all the elements present in soil except organic carbon and nitrogen.

Fly ash holds the potential to improve the physical health of the soil. It serves as a soil modifier and also enhances the water and nutrient uptake, helps in development of roots system. Use of fly ash in agriculture has shown to increase the yield of cereals, oilseeds, pulses, cotton and sugarcane by 10-15 percent and vegetables by about 20-40 percent as observed in experiments carried out under varied climatic conditions and soil types across the country with different doses of fly ash with and without organic manure in various crops [4,5,6]. Cultivation of medicinal and aromatic plants fetching attention to market for its good market value, In Maharashtra about 70 ha area under the cultivation of safed musli, Ashwagandha, citronella, lemon grass, kawach, menthol, etc .are observed.

2. MATERIALS AND METHODS

The field experiment was conducted during 2013-2014 on Inceptisol at Nagarjun Medicinal Plants Garden, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra). There were three levels of FYM (0, 10 and 20 t ha^{-1}) and four levels of fly ash (0, 5, 10 and 20 t ha^{-1}) with three replications arranged in FRBD. Fly ash and FYM were applied before transplanting safed musli (*Chlorophytum borivilianum*). The fly ash was collected from Thermal Power Station, Paras, Balapur, Dist. Akola (Maharashtra). Physico-chemical properties of the soil were studied after harvesting Safed musli. The growth observations viz, number of leaves and leaf area were

recorded upto 90 days. As after 90 days defoliation of the plants usually occurred in Safed musli. The number of leaves was recorded up to 90 DAP. The leaf area (cm^2) as influenced by various treatment was recorded after 30, 60 and 90 DAP by using the graphical method. Treatment wise plant and root biomass were selected randomly from each net plot and fresh weight recorded then Plant samples were air dried in shade and placed in oven at 65°C till the constant weight obtained. The data were statistically analysed following [7].

Table 1. Nutrients content in FYM and Fly Ash

Sr no.	Nutrients in Fly Ash	Values
1	Total Nitrogen (%)	0.038
2	Available N (%)	0.0025
3	Available P (%)	0.0034
4	Available K (%)	0.056
5	DTPA extractable Fe (ppm)	4.79
6	DTPA extractable Zn (ppm)	1.09
7	DTPA extractable Mn (ppm)	0.48
8	DTPA extractable Cu (ppm)	1.32

Sr. no.	Nutrient content in FYM	Value
1	N (%)	0.44
2	P (%)	0.19
3	K (%)	0.68
4	DTPA extractable Fe (ppm)	3.82
5	DTPA extractable Zn (ppm)	0.90
6	DTPA extractable Mn (ppm)	2.24
7	DTPA extractable Cu (ppm)	2.28

Table 2. Initial Soil status at the start of the experiment (*Kharif* 2011)

Sr. no.	Soil characteristics	Content
A	**Physical properties**	
1	Bulk density (Mg m^{-3})	1.54
2	Maximum water holding capacity (%)	45.85
3	Porosity (%)	37.39
4	Hydraulic conductivity (cm Hr^{-1})	0.86
B	**Chemical properties**	
1	pH(1: 2.5)	8.20
2	EC (dSm^{-1})	0.32
3	Available N (kg ha^{-1})	180.85
4	Available P (kg ha^{-1})	13.67
5	Available K (kg ha^{-1})	261.35
6	DTPA Mn (mg kg^{-1})	2.24
7	DTPA Zn (mg kg^{-1})	0.90
8	DTPA Cu (mg kg^{-1})	2.28
9	DTPA Fe(mg kg^{-1})	3.82

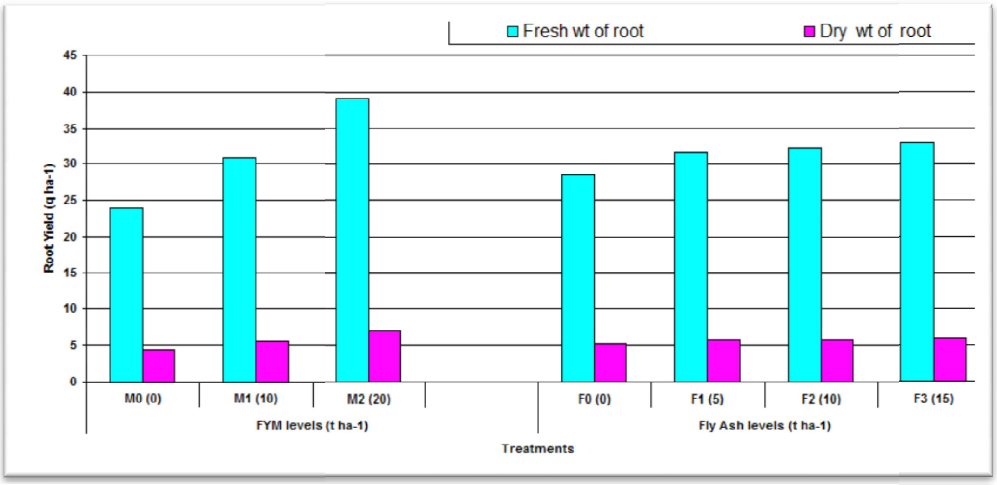

Fig. 1. Root yield of safed musli as influenced by FYM and Fly ash application

Table 3. Number of leaves plant^{-1} and Leaf area plant^{-1} (cm^2) as influenced by FYM and Fly ash application

Treatments	No. of leaves			Leaf area		
	Days after planting			Days after planting		
	30	60	90	30	60	90
FYM levels (t ha^{-1})						
M0 (0)	9.92	16.00	14.08	22.33	27.58	25.58
M1 (10)	10.25	15.75	15.42	23.58	29.42	27.33
M2 (20)	10.92	15.75	15.92	23.25	30.17	27.33
SE(m)±	0.38	0.26	0.23	0.30	0.21	0.28
CD at 5%	NS	NS	NS	0.88	0.60	0.83
Fly ash levels (t ha^{-1})						
F0 (0)	9.89	15.44	14.11	23.00	28.33	26.56
F1 (5)	10.00	16.33	15.22	23.22	29.00	26.44
F2 (10)	10.89	16.11	15.44	23.00	29.33	27.00
F3 (15)	10.67	15.44	15.78	23.00	29.56	27.00
SE(m)±	0.44	0.30	0.27	0.35	0.24	0.33
CD at 5%	NS	NS	NS	NS	0.69	NS
Interaction effect (FYM x Fly ash)						
SE(m)±	0.75	0.52	0.46	0.60	0.41	0.57
CD at 5%	NS	NS	NS	NS	NS	NS

Table 4. Dry matter accumulation (q ha^{-1}) as influenced by FYM and Fly ash application

Treatments	Plant leaf biomass			Root biomass		
	Days after planting			Days after planting		
	30	60	90	30	60	90
FYM levels (t ha^{-1})						
M0 (0)	1.28	1.58	1.47	2.84	2.88	3.61
M1 (10)	1.32	1.63	1.53	3.02	3.78	4.85
M2 (20)	1.34	1.64	1.60	3.16	3.88	6.34
SE(m)±	0.01	0.01	0.04	0.10	0.11	0.08
CD at 5%	NS	0.03	NS	NS	0.33	0.24
Fly ash levels (t ha^{-1})						
F0 (0)	1.30	1.59	1.53	2.94	3.24	4.42
F1 (5)	1.32	1.62	1.55	3.00	3.26	4.99
F2 (10)	1.33	1.62	1.54	3.05	3.76	5.1
F3 (15)	1.31	1.65	1.52	3.04	3.79	5.23
SE(m)±	0.01	0.01	0.04	0.12	0.13	0.09
CD at 5%	NS	0.03	NS	NS	0.38	0.27
Interaction effect (FYM x Fly ash)						
SE(m)±	0.03	0.02	0.08	0.2	0.22	0.16
CD at 5%	NS	NS	NS	NS	NS	NS

3. RESULTS AND DISCUSSION

The number of leaves was successively increased with each growth stage up to 60 days. However, no significant effect of FYM application was noticed on a number of leaves at various growth stages i.e, 30, 60 and 90 DAP. It is revealed from the data presented in Table 3 that fly ash levels also had a non-significant effect on number of leaves recorded at 30, 60 and 90 DAP.

Significantly highest leaf area was recorded with the application of 20 t FYM ha^{-1} (M_2) followed by

application of 10 t FYM ha^{-1} (M_1). This might be due to the availability of plant nutrients in addition to improvement in porosity, infiltration through organic manures, resulted into the increased leaf area significantly. The similar results were also reported by several authors [3,8].

The fly ash levels had non-significant effect on leaf area recorded during all the growth stages under study except at 60 DAP and significantly highest leaf area (29.56 cm^2) was recorded with the application of 15 t fly ash ha^{-1} which was at par with 10 t fly ash ha^{-1} (F2) and 5 t fly ash ha^{-1} (F1). The incorporation of fly ash in soil was found to be helpful for crop/plant growth was also reported by several workers [9,10]. Significantly highest dry matter accumulation of leaves was recorded with the application of 20 t FYM ha^{-1}, however, it was at par with 10 t FYM ha^{-1}. Whereas, as dry matter accumulation by roots was found significantly influenced by the application of different levels of FYM at 60 and 90 days after planting. The dry matter accumulation was significantly highest with the application of 20 t FYM ha^{-1} however, it was at par with 10 t FYM ha^{-1} at 60 DAP. The significant effect of FYM application on dry matter accumulation might be due to the supply of balanced nutrients to the crop plants. The dry matter accumulation rate was found rapid to very rapid from 30 days growth period upto 60 days, which was on account of the increased number of leaves and leaf area. During the growth period of 85 to 90 days, the defoliation started in the crop plant may be the reason for non significant result of FYM application on dry matter accumulation.

The highest biomass accumulation was observed with 15 t fly ash ha^{-1} (F3) which was at par with 10 t fly ash ha^{-1} (F2) and 5 t fly ash ha^{-1} (F1). Whereas the dry matter accumulation by roots and plants was non-significant at 30 DAP and dry matter accumulation by plants at 90 DAP During the growth period of 85 to 90 days, the defoliation started in the crop plant may be the reason for non significant results of fly ash application on dry matter accumulation. Reddy et al. [11], revealed that application of fly ash, FYM and their interactions had significant affect on yield and available nutrient status of soil after harvest of rice crop with the application of fly ash @ 10 t ha-1 along with FYM @ 10 t ha^{-1} is recommended for rice crop grown in Typic Haplustept soils of the Southern Telangana Zone of Andhra Pradesh.

4. CONCLUSION

From the present study, it is revealed that the application of 20 t FYM ha^{-1} recorded significantly highest leaf area and leaf and root biomass accumulation at 60DAP. Similarly, significantly highest leaf area, leaf and root biomass accumulation recorded with the application of fly ash @ 15 t ha^{-1} which was at par with 10 t fly ash ha^{-1} (F2) and 5 t fly ash ha^{-1} (F1). Therefore, it is concluded that the application of FYM @ 20 t and fly ash @ 5 t ha^{-1} was found beneficial way to enhance the growth attributing characters and biomass accumulation of Safed musli.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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