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Understanding the Effect of Floral Waste Biocompost and Agnihotra ash on Soil Fertility and Plant Growth using Central Composite Design

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ABSTRACT

Enormous measures of flowers are presented in temples in India making a lot of floral waste. The temple squanders are delivered in the water bodies or unloaded at the accessible spots of land which makes extreme environmental pollution and wellbeing hazards. Composting of floral waste in blends with dry leaves and cow dung were ready to lead the review. Debased floral waste deposits effectively are a modest and adaptable wellspring of decision for biocompost. Agnihotra is a process of refinement of the environment through the agency of element 'Fire'. Preliminary study was carried out to optimization of different types and concentration of biocompost and Agnihotra ash. Central composite design was employed for optimization of the effect of independent variables such as biocompost and Agnihotra ash on responses such as germination, root length and shoot length. Various experiments have been planned to get scientific explanations which confirm the impact of Agnihotra ash on soil fertility and plant life. Agnihotra ash has a beneficial effect on seed germination and growth of plants, nevertheless it was found that very higher amount of it adversely affects the plant growth. An effort has been made here to show how Agnihotra ash contributes in a positive way, as enhancer of the environment and plant health. So in this study we check the combined effect of floral waste biocompost and Agnihotra ash on plant growth and soil health.

Key words: *Agnihotra ash, Floral waste, Biocompost, Soil fertility, Central composite design*

Introduction

Floral Waste Biocompost

Flowers can be utilized as substrate for biocomposting. Biocomposting is a suitable technology for bioconversion of floral waste into biocompost and decrease of solid waste pollution. It very well may be effectively applied in temples as a strong waste management methodology with flowers as the significant organic waste (Waghmode *et al*., 2018). This can be significant elective methodology in maintainable waste management. Biocomposting technology for bioconversion of floral waste into biocompost will assist with lessening volume of temples squander and furthermore create extra income for the temples. The organic parts of floral squander biocompost and microorganisms in the biofertilizers can be an option in contrast to chemical composts to work on the development and

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([1]*Research Scholar, [2]Research Scholar, [3]Associate Professor, [4]Professor) yield of different plants. There is a report of solid waste management of floral waste contributions by biocomposting using microbial consortium. The principal benefit of biocomposting is that it is one of the eco-friendly technologies since it defeats the issue of organic waste removal and furthermore mitigates the scent issue. Biocomposting likewise cleans the climate and gives gainful organic fertilizer. Floral waste can be changed over into a manure or soil conditioner, a worth added item. The manure or soil conditioner from flower waste can be utilized to expand the development of many plants. The transformation of floral waste into biocompost utilizing flower squanders (rose, jaswand and mogra). The biocompost acquired was wealthy in carbon (28%), nitrogen (1.58%), phosphorus (0.33%) and potassium (0.28%). The biocomposting has been conveyed to change over floral waste into valuable organic compost of the plants which is exceptionally fundamental (Jadhav *et al.*, 2013).

Agnihotra ash and floral waste biocompost and Homa Farming

The fundamental Agnihotra (sanskrit: agni = fire, hotra = recuperating), is rehearsed in the beat of sunrise and sunset. A little fire is ready from dried cow dung and explained spread (ghee) in a copper pyramid. A few grains of whole rice are placed into the fire accompa-nied by reciting a mantra. The ash created by the fire is licensed with having mending properties. Add in water and showered onto plants, it is said to have fertiliz-ing as well as plant safeguarding quality. Homa farming might be applied as a corresponding strategy along with common techniques for natural farming. Two or three reports from India, Peru, Venezuela, the United States and Austria, some of them including logical documentation, give record of the gainful impacts of Agnihotra ash and floral waste biocompost on plant germination, improvement, wellbeing and pest resistant, as well as on yield and product quality with respect to soil quality, a better water holding capacity, an expansion in sum and solvency (plant accessibility) of macro nutrients and minor components and a feeling of worm movement are proposed as an immediate consequence of Agnihotra ash and floral waste biocompost treatment. The referred to reports demonstrate to areas of strength for Agnihotra ash and floral waste biocompost for further developing plant execution in an ecologically sound way. Nonetheless, an essential for a more extensive acknowledgment of this strategy is a reasonable logical documentation in view of replicable and precise tests. While the majority of the above referred to impacts of Agnihotra ash and floral waste biocompost treatment have not yet been deductively made sense of or demonstrated, first investigations on the subject of supplement dissolvability with two Colorado soils uncovered an expansion in P solvency when the soil were treated with Agnihotra ash and floral waste biocompost (Lai, no year). The point of this review was to test on the off chance that the outcomes detailed by Lai (no year) could be replicated with a German rural soil under controlled research centre circumstances (Abhang, *et al.*, 2015; Kratz and Schnug, 2007).

In this work we used central composite design (CCD) for optimizing the effect of floral waste biocompost and Agnihotra ash on plant and soil An embedded factorial or fractional factorial design with centre points exists in a Box-Wilson Central Composite Design, also known as a "central composite design," which is supplemented with a collection of "star points" that enable curvature estimate. The distance between the design space's centre and a star point is | | > 1 if the distance between the centre and a factorial point is 1 unit for each factor. The exact amount of relies on the number of components involved and some desired design features.

Materials and Methods

Production of Floral Waste Bio compost

The agitated piles contained 90 kg to 100 kg of waste combination and were manually turned on at intervals of 4 d and the samples were analysed. Two replicates were prepared for each pile. The parameters were monitored every four days for 60 d. Initially all the piles were covered with plastic sheet for four days. The pile combinations used are shown below (Mulay *et al.*, 2020; Sharma and Yadav, 2017).

Combination: 66 kg floral waste + 14 kg cow dung + 20 kg dry leaves

Production of Agnihotra ash and floral waste biocompost

Through Agnihotra Yajna Producing Agnihotra ash and floral waste biocompost

Effect of Agnihotra ash and floral waste biocompost on Germination of Wheat, Mung (*Vigna radiata*) and Tomato

Germination Test

Seeds of *Mung* (*Vigna radiata*) were surface sterilized with 5% sodium hypochlorite for 5min, then rinsed with distilled water several times to remove any trace of sodium hypochlorite. The seeds were classified into two groups. Then seeds were incubated with Agnihotra ash and floral waste biocompost for 2 hours. Water treated seeds were used as control. Control and treated seeds (10 seeds per pot) were sown in sterilized pot containing autoclaved soil (approximately 100 g). All pots were labelled properly. The pots were kept at 30 ± 2°C, 60% relative humidity, under 8 hours/16 hours dark/light photoperiod. Pots were observed and watered regularly during this period. After10 days and 23 days, plants were harvested and their growth parameters were analysed. At the end of the experiment total fresh weight, length of shoots and roots per plant were determined.

Analysis of sterile soil

The soil was sterilized by autoclaving, through sterilization for 2 h at 121.4 °C and 15 lbs. pressure to destroy microbes and spore from soil. The physicochemical properties of soil should be documented. Plastic pots of 6 inch size were employed in the study.

Effect of Floral waste biocompost and Agnihotra ash and floral waste biocompost on Growth of Mung plants

Plant Germination Experiments

To study effect of Agnihotra ash and floral waste bio compost and floral waste bio compost on germination of plant, following water and bio compost were used a. Control soil b. Agnihotra ash and floral waste biocompost with bio compost (1g Agnihotra ash and floral waste bio compost + 30 g bio compost + 70 g soil). The germination process has several stages. The following are some of the steps in seed germination: The seed coat bursts as it absorbs water. It's the first indicator that the seed has germinated. Enzymes are activated, respiration increases, and plant cells are multiplied. A series of chemical changes begins, leading to the formation of the plant embryo. During the germination process, chemical energy held in the form of starch is transformed to sugar. The embryo expands quickly, and the seed coat bursts open. A growing plant emerges from the ground. The tip of the root emerges first, assisting in the anchoring of the seed. It also enables the embryo to absorb nutrients and water from the surrounding environment.

Seed Selection: Fig. 1 shows the selected mung seeds for check the effect

Fig. 1. Mung seeds

Optimization using central composite design (CCD)

A five level two factor rotatable central composite design (α = 1.41) was employed to evaluate influence of independent variables [Agnihotra ash (X_1), Biocompost (X_2)] on quality attributes. The design consisted of four factorial points, four axial points and one centre points with total 9 runs (Table 1) in total. A statistical model incorporating interactive and polynomial terms was used to calculate the responses (Patel *et al.*, 2014).

$$Y = b_0 + b_1X_1 + b_2X_2 + b_{12}X_1X_2 + b_{11}X_1X_1 + b_{22}X_2X_2 \quad .. (1)$$

Where, Y is the dependent variable, b_0 is the arithmetic mean response of the all trials, and b_i(b_1, b_2, b_{12}, b_{11} and b_{22}) is the estimated coefficient for the corresponding factor X_i (X_1, X_2, X_1,X_2, X_{11} and X_{22}), which represents the average result of changing one factor at a time from its low to high value (Garala *et al.*, 2013). The interaction term (X_1X_2) shows how the response changes when two factors are concurrently altered. The polynomial terms (X_1X_1 and X_2X_2) are included to investigate the nonlinearity (Patel *et al.*, 2014).

Results and Discussion

Germinated mung seed shown in Fig. 2 in which control and experimental both seed's shoot, root and leaves are observed clearly.

Fig. 2. Germinated Mung Seed

Table 1. Rotatable central composite design layout

Trials	Variable level in coded form	
	X_1	X_1
1	-1	1
2	1	-1
3	0	+α
4	0	0
5	-1	-1
6	-α	0
7	0	-α
8	1	1
9	+α	0

Coded Values	Actual Values	
	X_1 = Agnihotra ash(g)	X_2 = Biocompost (g)
-1	1	10
0	5.5	55
1	10	100

Experimental design (CCD)

Preliminary investigations of the process parameters exposed that factors such as Agnihotra ash (X_1) and Bio compost (X_2) exhibited significant influence on germination and overall growth of plant; hence, they were applied for additional systematic studies. All selected dependent variables for all trials showed a wide variation of data (Table 2). The statistics undoubtedly specify the robust impact of X_1 and X_2 on particular responses. The polynomial equations can be used to draw deductions after considering the magnitude of coefficients and the mathematical sign carried: positive or negative (Garala *et al*., 2011).

Effect of independent variable on Germination (Y_1)

Concerning Y_1, the results of multiple linear regression analysis showed that the coefficients $b_1$bear a negative sign and b_2 bear a positive sign. The negative of X_1 coefficient indicates that as the amount of Agnihotra ashincreases; there is decrease in the germination. But the reduced model implied that it is insignificant at p e" 0.05 (Patel, *et al*., 2014). The positive of X_2 coefficient indicates that as the amount of Biocompost increases; there is increases in the germination. The fitted equation relating the response Y_1 to the transformed factor is shown in following equation,

$$Y_1 = 84.962 - 3.503X_1+4.804X_2-8.454X_1^2-0.101X_2^2 + 0.072X_1X_2 \quad .. (2)$$

The Y_1 for all batches F1 to F9 shows good correlation co-efficient of 0.82.Variables which have p value less than 0.05, significantly affect the germination. The relationship between formulation variables (X_1 and X_2) and Y_1 was further elucidated using contour plot and perturbation plot. The effects of X_1 and X_2 on Y_1 are shown in Fig. 3 (a) and (b). Table 2 showed that with the increase of amount of Agnihotra ash

Up to middle level, i.e., 5.5, germination is in-

Table 2. Results of experimental design batches of variables

Trials	X_1(g)	X_2(g)	Y_1*(˚C)	Y_2*(cm)	Y_3* (cm)
F1	1	100	80.79 ± 1.23	16.21 ± 1.03	12.97 ± 0.81
F2	10	10	62.88 ± 0.93	8.91 ± 1.14	7.55 ± 0.71
F3	5.5	118.45	96.42 ± 1.54	17.85 ± 0.73	15.11 ± 1.25
F4	5.5	55	85.12 ± 2.36	14.98 ± 1.63	12.14 ± 2.14
F5	1	10	71.85 ± 1.35	13.21 ± 2.34	9.94 ± 1.23
F6	0	55	76.21 ± 3.04	11.54 ± 1.54	9.57 ± 1.73
F7	5.5	0	82.09 ± 2.4	10.53 ± 2.48	9.31 ± 1.44
F8	10	100	72.11 ± 1.15	13.28 ± 1.36	10.13 ± 1.87
F9	11.98	55	68.87 ± 2.07	9.53 ± 1.02	8.14 ± 1.19

*All the values are in mean ± S.D. (n=3), X_1=Agnihotra ash (g.), X_2=Biocompost (g.), Y_1=Germination (%), Y_2=Shoot Length (cm), Y_3=Root Length (cm).

creased but after middle level, it was decrease significantly as also observed from perturbation plot (Fig. 3). It was also found from perturbation plot that upon increasing X_{1-}, germination was also significantly improved.

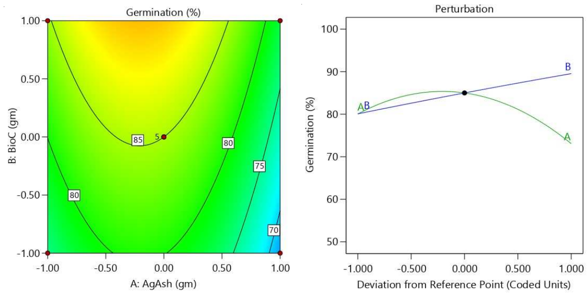

Fig. 3(a). Contour plot showing effect of variables [Agnihotra ash(X_1) and Biocompost (X_2)] on Germination; (b) the corresponding perturbation plot

Regarding Y_2, the results of multiple linear regression analysis showed that coefficient b_1 bear negative sign and coefficient b_2 bear a positive sign. The positive X_2 coefficient indicates that as the amount of X_2 (Biocompost) increases; there is increase in the shoot length. Perturbation plot in Figure shows that as amount of X_1 (Agnihotra ash) increase from level -1 to 0, there is slight increase in shoot length and further increase in Agnihotra ashleads to declining the shoot length. The fitted equation relating the response Y_2 to the transformed factor is shown in following equation,

$$Y_2 = 14.994- 1.259X_1 + 2.215X_2- 2.094X^2_1- 0.267X^2_2 + 0.343X_1X_2 \quad ..(3)$$

The Y_2 for all batches F1 to F9 shows good correlation co-efficient of 0.9526. Variables which have p value less than 0.05, significantly affect the shoot length. The relationship between independent variables (X_1 and X_2) and Y_2 was further elucidated using contour plot and perturbation plot. The effects of X_1 and X_2 on Y_2 are shown in Fig. 3 (a) and (b).

Result of the testing are shown in table. We take different combination and concentration of biocompost and agnihotra ash in which biocompost and agnihotra ash shown positive effect on seed germination and plant growth.

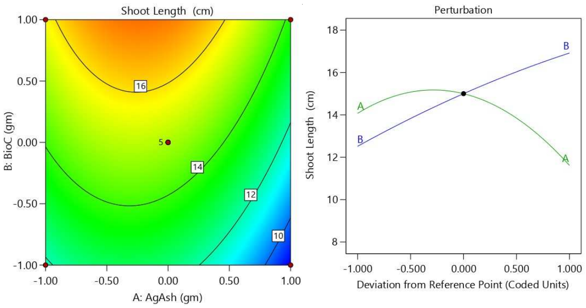

Fig. 4(a). Contour plot showing effect of variables [Agnihotra ash(X_1) and Biocompost (X_2)] on Shoot length; (b) the corresponding perturbation plot

Effect of independent variable on Root Length (Y_3)

About Y_3, the outcomes of multiple linear regression analysis exhibited that the coefficients $b_1$bear a negative sign and b_2 bear a positive sign. The negative of X_1 coefficient indicates that as the amount of X_1 (Agnihotra ash) increases; there is decrease in the root length. Further, as shown perturbation plot (Figure 4), it was found that as we increase X_1 from -1 to 0, there is increase in root length. The positive of X_2 coefficient indicates that as the amount of X_2 (Biocompost) increases; there is increase in the root length, also results confirmed from the perturbation plot (Figure 4). The fitted equation relating the response Y_3 to the transformed factor is shown in following equation,

$$Y_3 = 12.08 - 0.907X_1 + 1.727X_2- 1.709X^2_1- 0.031X^2_2 + 0.113X_1X_2 \quad ..(4)$$

The Y_3 for all batches F1 to F9 appearances excellent correlation co-efficient of 0.9544. Variables which have p value less than 0.05 (Dhingani, *et al.*, 2014), significantly affect the root length. The relationship between formulation variables (X_1 and X_2) and Y_3 was further elucidated using contour plot (Figure 5).

Optimization of independent variables

The optimized composition was obtained by applying constraints on dependent variable responses and independent variables. The constraints were maximum germination, shoot length and root length. These constrains were common for all the trials. There commended concentrations of the independent variables were calculated by the Design Expert® version 13 Stat-Ease, Inc., MN,USA)software from the overlay plot (Fig. 6). The optimum values of selected variables obtained were 0.18 (X_1; Agnihotra ash) and 0.69 (X_2; Biocompost. The nal optimized composition comprised of 0.81 g. Agnihotra ash, 31.05 g. Biocompost. All of the rel-

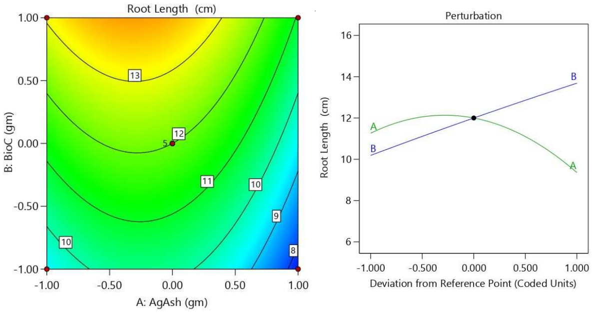

Fig. 5(a). Contour plot showing effect of variables [Agnihotra ash(X_1) and Biocompost (X_2)] on Root length; (b) the corresponding perturbation plot

evant covariates had strong connections to the dependent variables, according to the results of the regression analysis (Raval *et al*., 2021). Check point/ optimized batch was executed according to the levels of factors optimized. The outcomes depicted non significantly (p> 0.05) difference and lower magnitude of % relative error between experimentally obtained and the erotically computed data of Germination (%), Shoot Length (cm) and Root Length (cm) as well as significantly values of R^2 suggested the robustness of mathematical model and high predictive ability of applied model (Garala, *et al*., 2013) (Table 3 to 5).

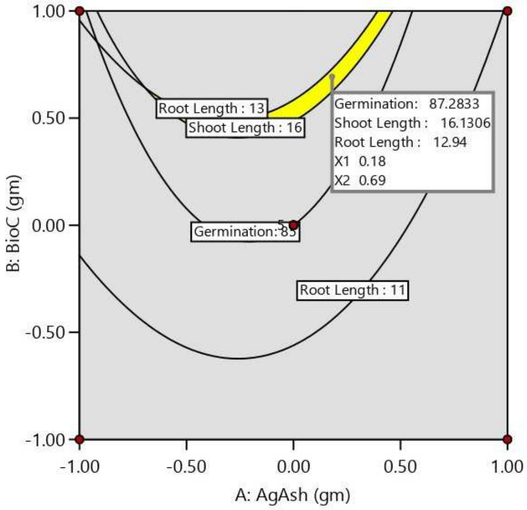

Fig. 6. Overlay plot for optimized parameters

Table 4. Calculation of testing the model in portions

	Germination			
	DF	SS	MS	R^2
	Regression			
FM	5	787.718	157.543	0.82
RM	2	689.413	344.706	0.72
Error				
FM	7	168.926	24.132	
RM	10	267.230	26.723	
	Shoot Length			
	DF	SS	MS	R^2
Regression				
FM	5	82.928	16.586	0.95
RM	3	81.963	27.321	0.94
Error				
FM	7	4.125	0.589	
RM	9	5.090	0.566	
	Root Length			
	DF	SS	MS	R^2
Regression				
FM	5	51.045	10.209	0.95
RM	3	50.987	16.996	0.95
Error				
FM	7	2.437	0.348	
RM	9	2.495	0.277	

DF, degree of freedom; SS, sum of squares; MS, mean of squares; R^2, regression coefficient.

Table 3. Summary of regression analysis

Coefficients	b_0	b_1*	b_2	b_{11}	b_{22}*	b_{12}*
			Germination			
FM	84.962	-3.503	4.804	-8.454	-0.101	0.072
RM	84.891	-	4.804	-8.445	-	-
			Shoot Length			
FM	14.994	-1.259	2.215	-2.094	-0.267	0.343
RM	14.808	-1.259	2.215	-2.060	-	-
			Root Length			
FM	12.080	-0.907	1.727	-1.709	-0.031	-0.113
RM	12.058	-0.907	1.727	-1.705	-	-

FM full model, RM reduced model, *Response is insignificant at $p \geq 0.05$

Table 5. Results of optimized batch

Response	Predicted value	Experimental value*	% Relative error
Germination (%)	87.28	90.12 ± 2.45	+ 3.15%
Shoot Length (cm)	16.13	15.89 ± 1.03	-1.51%
Root Length (cm)	12.94	13.27 ± 1.17	+ 2.49%

*Values are of mean of three observations ±SD

Conclusion

The results, clearly suggest that Agnihotra ash and floral waste bio compost assisted germination and can therefore be used as a fertilizer. This demonstrates how Agnihotra ash and floral waste bio compost benefits the environment and plant health in a favourable way. Agnihotra ash and floral waste bio compost has ensured healthy plant growth. Agnihotra's atmosphere and ash can be used as adjuvant in the 'Natural farming' methods also known as the Agnihotra farming methods. Agnihotra Yajna is relatively affordable; it has a positive impact on the environment and soil health. So we concluded that combined effect of floral waste bio compost and Agnihotra ash shown positive effects on soil fertility and plant health

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Conflict of Interest

The authors declare that they have no conflict of interest.

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