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COMPARISON OF GROWTH CHARACTERISTICS AND YIELD OF TWO TYPES OF OYSTER MUSHROOM (*PLEUROTUS* SPP.) ON DIFFERENT SIMPLE AND COMPLEX CELLULOSIC RESIDUES

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ABSTRACT

This study investigated the impact of various plant cellulosic residues as substrates and co-substrates on the growth and yield of two oyster mushroom species: *Pleurotus ostreatus* (PO) and *Pleurotus eryngii* (PE). The research involved two parallel experiments, comparing sugarcane bagasse (S1) and sawdust (S2) as substrates with three co-substrate treatments: no addition (W0), 20% sunflower seed hulls (W1), and 20% peanut shells (W2). The substrates were sterilized using hot water with the 2% $CaCO_3$ solution and inoculated with 3% spawn. Mushrooms were grown in 1 kg polyethylene bags within a specially designed growth chamber under controlled conditions.A total of six treatments were evaluated: S1W0, S2W0, S1W1, S2W1, S1W2, and S2W2, using a Completely Randomized Design (CRD) with five replications. Results demonstrated that *P. ostreatus* consistently outperformed *P. eryngii* in growth and yield. The S1W0 treatment *for P. ostreatus* showed the highest biological efficiency (90.40%), flush count (4.66), fruiting body count (8.33), and crop cycle (71.67 days). In the S1W1 treatment, *P. ostreatus* produced the highest total yield (307 g), the greatest number of fruiting bodies (8.33), and the fastest mycelial colonization was (43 days). This highlights the efficiency of sunflower seed hulls as a co-substrate in enhancing growth. On the other hand, *P. eryngii* displayed significant results under the S1W1 treatment, achieving a total yield of 169.7 g and higher fruiting body weight 84.83 g. For *P. ostreatus*, the heaviest fruiting bodies were observed in the S2W2 treatment, weighing 48.42 g on average, while *P. eryngii* had the highest flush weight (123 g) in the S1W2 treatment. The results suggest that sugarcane bagasse (S1) combined with sunflower seed hulls (W1) is the most optimal substrate combination for *P. ostreatus*, providing superior yield, biological efficiency, and faster growth. This study highlights the potential of utilizing agricultural residues like sugarcane bagasse and sunflower seed hulls for sustainable mushroom production. The use of waste materials as substrates could also contribute to reducing agricultural residue waste, presenting both economic and environmental benefits. The findings also suggest that *P. eryngii* may require specific conditions to achieve optimal productivity, although its response to certain treatments presents promising possibilities for further research and optimization.

Key words: Substrate, Co-substrates, Spawning, Pin-head, Mycelium, Biological efficiency, Agricultural residues

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INTRODUCTION

Mushrooms are neither plants nor animals but they have been placed in a kingdom of their own called the kingdom of Myceteae [1]. The genus *Pleurotus* is the most exploitable xylotrophic fungi, with valuable biotechnological, medicinal, and nutritional properties [2]. The mushroom can convert lignocellulosic waste materials into human food to produce notable nutraceutical products. The choice of a suitable waste material as substrate is essential for the cultivation of *Pleurotus* spp. to obtain a preferable yield [3]. Cultivation of *Pleurotus* mushrooms proves to be highly advantageous and economically serviceable across a spectrum of the climate conditions; it encompasses tropical, subtropical, and temperate areas [4]. *Pleurotus* spp. (Oyster mushroom) are one of the mushrooms that have high production worldwide [5]. Presently, several of the genus *Pleurotus* spp. have excellent commercial value in the global market of edible mushrooms [6]. On a global scale, it is ranked second amongst commercially cultivated mushrooms, following *Agaricus* spp., and represents about one-fourth of total mushroom world production [7]. *The Pleurotus* genus comprises edible mushrooms cultivated globally under diverse conditions. Their growth on a variety of substrates and co-substrates, combined with adaptable cultivation practices, enhances their nutritional profile by increasing macronutrient and mycochemical content [8]. The *Pleurotus* spp. include over 200 saprophytic species distributed worldwide in moderate and tropical environments. The most common and commercial species of *Pleurotus* genera are: *P. ostreatus, P. eryngii, P. djamor* and *P. citrinopileatus* [9]. Both of *Pleurotus osteratus* and *Pleurotus eryngii* commonly known as the king oyster are a palatable mushroom with the best commercial potential due to the relative ease of their growing technology, low production cost with better yield potential making them used extensively and popular worldwide [10, 11]. Furthermore, their efficient cultivation practices not only ensure robust production but also make them one of the best sources of mycoprotein—a nutrient-rich fungal protein derived from edible mushrooms. Efficient production is achieved by propagating and nurturing the mushrooms within precisely controlled environments [12]. The highest protein content among the different species of *Pleurotus* was observed for *P. ostreatus* (23.0%) and *P. pulmonarius* (22.9%), comparable to pea protein (20–30%) or chickpea (20–25%) [13]. On the other hand, the *Pleurotus* species have low-fat content (2.7%), particularly, species with relatively high-fat contents are *P. eryngii* (3.5%) and *P. geesteranus* (3.5%) but these do not exceed the limit of 6% indicated by the Food and Drug Administration to comply as a low-fat food [14]. *Pleurotus* species use lignocellulosic substrates to develop their edible fruiting bodies, which have high nutritional and nutraceutical properties. Certain agricultural byproducts, such as tea waste and spent beer grains, can serve as substrates for cultivating the edible oyster mushroom (*P. eryngii*) to

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produce bioprotein. This approach offers a simple, cost-effective cultivation method with high yields and the flexibility to utilize a wide range of substrates [15-17]. The C/N ratio (28–30% carbon and 1% nitrogen) is an important condition for spawn running and mushroom production [18, 19]. Many studies have been conducted to test the ability of *Pleurotus spp.* to grow on different agro-wastes, such as sawdust, sunflower hulls, sugarcane bagasse, cotton seed waste, paper waste [20-22], wheat straw, wheat bran, rice straw and rice bran [1,23], banana leaves, and maize stalks and leaves [24]. This study aimed to improve the cultivation and production of oyster mushrooms and find suitable alternative substrates with co-substrate that utilize unused local agricultural waste for oyster mushroom production.

MATERIALS AND METHODS

Two experiments were conducted over the same duration and under identical incubator and production room conditions in College of Agriculture, Tikrit University, Iraq, for the period from 7-Nov.-2021 to 31-Mar.-2022 to test two species of oyster mushrooms and compare them in growth, yield and some morphological characteristics. The first experiment included *Pleurotus Ostreatus* (P80, Jacq.Fr, Dutch Hollander), and the second included *Pleurotus eryngii* (008, DC. Quél, National Centre for Organic Agriculture and mushroom production, Ministry of Agriculture, Iraq). Each experiment included two factors, the first representing the type of substrate (Sugarcane S1, Sawdust S2). The second factor, included co-substrates (without co-substrate W0, Sunflower seed hulls W1, Peanut shells W2). Each experiment included six treatments, as shown in Table 3. Both experiments were designed according to a Completely Randomized Design (C.R.D.), with six replications for each treatment.

Preparation of the substrate and co-substrate

Collected sun-dried agro-waste which consists (sugarcane bagasse, sawdust, sunflower seed hulls, and peanut shells) were cut into pieces (appropriate size) with an electric cutter. Each treatment was soaked in hot tap water (100°C) for 45 minutes to ensure it sterilized in a good safe way, after that the materials were dried to obtain an average moisture content of 65± 1%, calculated by drying 100 g of substrate in an oven at 60°C until constant weight was achieved. Both substrate and co-substrates were tested by some laboratory analyses as shown in Table 4.

A wide range of techniques are used to characterize substrates and co-substrates. Elemental analysis is used to determine nitrogen and carbon content, and the protein content is estimated from the nitrogen content. Carbohydrate is determined by chromatography; ash content is determined by incineration. Fibre content is reported according to standard protocols, and organic matter is derived as the mass remaining after determining ash content; porosity and absorption rates are

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assessed via water absorption tests or analogous methods; and the carbon-to-nitrogen (C/N) ratio is obtained from measured carbon and nitrogen values.

Preparation of the treatments inoculated with spawn

Polyethylene bags (25×40 cm) were filled with the experimental treatments as outlined in Table 3. For treatments T1 and T2, each bag contained 1 kg of substrate. For treatments T3, T4, T5, and T6, a mixture of 800 g of substrate and 200 g of co-substrate was used to maintain a total weight of 1 kg (based on wet weight). Additionally, 20 g of calcium carbonate ($CaCO_3$) was added to each bag and thoroughly mixed. The bags were then inoculated with spawn grains at a rate of 3% of the wet weight using sterile hands [27].

Preparation of the cultivation room

The bags inoculated with the spawn were placed in the incubator at a temperature of 25-27°C with darkness provided [28]. After the mycelium spread on most of the bags, the temperature was reduced from 25 to 14±1°C to apply a cold shock while raising the humidity to 90±2% by spraying water on the walls twice a day, with lighting provided for 8-10 hours.day^{-1} and lighting intensity of 400 lux. hour^{-1} with lowering CO_2 and raising O_2 percentage [29]. A sharp, sterile scalpel was then used to make holes in the bags to allow the Pin-head to easily form. Fruiting bodies were harvested (3 to 8 days) after the emergence of primordia by hand by gently twisting them [30]. This variation time depended on components of treatments and mushroom species. The conditions continued to stimulate the formation of fruiting bodies until the end of the first harvest, then a return to the incubation period (10 days).

Measures and Harvesting

The mushroom bags were monitored daily, data and changes in the studied traits were recorded. Differences in the speed of mycelium propagation as well as the periods of harvesting the fruiting bodies were recorded [31].

Yield and Fruiting Body Traits

Yield and Fruiting Body Traits were evaluated based on total yield, the number of fruiting bodies, the number of flashes, the average weight of individual fruiting bodies, the average harvest weight, and biological efficiency (Bio-efficiency) [32].

Growth and Spread Traits

Growth and Spread Traits were assessed based on the production cycle, spawn run period, primordia formation period, and fruiting time (maturity) [33].

Statistical analysis

The Experimental data were analyzed using One-way analysis of variance (ANOVA), according to a completely randomized design (CRD), and Tukey's

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multiple range test (Tukey's HSD test) was used to separate mean values at a significance level of $p \leq 0.05$. All data were analyzed using the Genstat data [34].

RESULTS AND DISCUSSION

Table 1. shows some characteristics of the fruiting bodies for the yield of the fungi *P. ostreatus* and *P. eryngii*, respectively. Table 1A. shows that the T3 (S1W1) treatment was significantly superior over T2 (S2W0), T4 (S2W1) and T6 (S2W2) and gave the highest yield of 307.0 $g.kg^{-1}$, followed by the T1 (S1W0) and T5 (S1W2) treatments. The yields of T1 (S1W0) and T5 (S1W2) reached 301.3 and 247.0 $g\ kg^{-1}$, respectively, while treatment T2 (S2W0) gave the lowest yield of 119.7 $g\ kg^{-1}$. As for the number of fruiting bodies, T1 (S1W0) and T3 (S1W1) recorded the highest number of fruiting bodies, amounting to 8.33 fruiting bodies. Therefore, it was significantly superior to the rest of the coefficients. Treatment T1 also recorded the highest number of flashes, amounting to 4.66 times, significantly superior to the rest of the treatments. As for the treatment T6 (S2W2), it was statistically superior in terms of fruiting body weight, recording 48.42 g and treatment T5 (S1W2) was significantly superior ($p \leq 0.05$) to the rest of the treatments in terms of highest yield per bag, recording 108.06 g. $flash^{-1}$. The biological efficiency characteristic was recorded by the treatment. T1 reached 90.40%, making it statistically the highest value in this characteristic compared to the rest of the experimental parameters. As for the results of Table 1B, treatment T3 (S1W1) recorded the highest total yield value of 169.7 $g.kg^{-1}$ and thus outperformed all treatments in terms of total yield. As for the number of fruiting body, T1 (S1W0) and T3 gave the highest value, amounting to 2.0 fruiting body, while the lowest value was recorded, amounting to 1.0 fruiting body, for both treatments T4 (S2W1) and T5 (S1W2). Treatment T3 (S1W1) recorded the highest value of 2.33 flashes, while the lowest value was recorded by treatments T2(S2W0) and T4(S2W1), which amounted to 1.0 flashes. Treatment T5 gave the highest fruiting body weight, amounting to 123.0 g, while treatment T1 recorded the lowest value amounting to 69.50 g. Treatment T3 gave the highest bio-efficiency reaching 48.48%, while the T4 treatment gave the lowest bio-efficincy, amounting to 33.5%.

a	b	c

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Figure 1: Fruiting body formation of *P. ostreatus* (a) mycelia run (b) pin-head formation (c) fruiting body formation

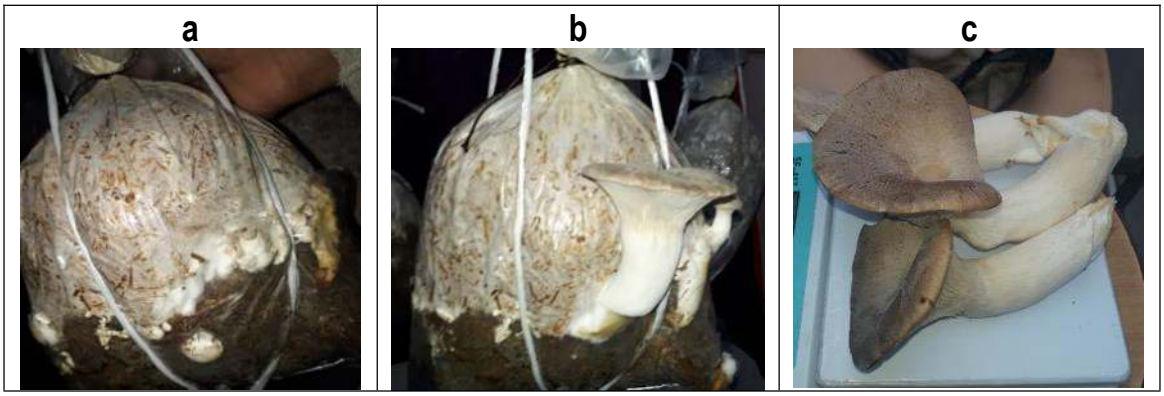

Figure 2: Fruiting body formation of *P. eryngii* (a) mycelia run (b) pin-head formation

Table 2 also shows the growth stages of *P. ostreatus* and *P. eryngii* sequentially. Table 2A showed that each of the treatments T2, T3, T4, T5 and T6 recorded the least significant duration in the production cycle, amounting to 39.67, 53.33, 44.33, 30.00, and 30.00 days, respectively, superior to treatment T1. As for the duration of mycelium proliferation, treatment T3 gave the shortest period, amounting to 43.33 days, superior to all treatments except treatment T1.

Also, the shortest period for pin-heads to form was 8.33 days, recorded by treatment T1, and thus statistically superior ($p \leq 0.05$) to the rest of the treatments. The T4 treatment also gave the shortest period required for the formation of fruiting bodies, amounting to 6.66 days. As for the results of Table 2B, it is clear that treatment T2 had a significant superiority, recording the shortest production cycle, which amounted to 9.0 days, while it was longer for treatment T4, which amounted to 42.7 days. The T3 treatment also recorded a significant difference in the shortest duration of mycelial proliferation, formation of pin-heads and formation of fruiting bodies, which reached 32.67, 7.67 and 7.66 days, respectively, while the longest duration for the same traits reached 108, 21 and 12 days, respectively, for the T2 treatment.

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From the results of Table 1A, it is clear that the fortifications (co-substrate) had a significant role at the ($p \leq 0.05$) level in improving the quantity of yield and some of the fruit traits that were estimated. This is because fortification with plant cellulosic residues has a role in enriching the medium with nutrients that are important for the growth and development of oyster mushrooms, as reported by Hassan and Muhammad [35]. As for the superiority of one fortifier over the other, it was found in the same table that the fortification treatment with sunflower hulls was the best in terms of yielding quantitative results, this may be due to the fact that the sunflower hulls contain a higher protein percentage, a relatively lower C/N ratio, and better porosity, as indicated in Table 4. It can be explained that the increase resulting from the T3 treatment of the *P. ostreatus* resulted in a relative reduction in the mean fruit due to the inverse relationship between the amount of total yield and the average weight of the mean fruit body, which amounted to 0.9529, as shown in correlation Table 5 [36]. As for Table 1B, treatment T3 also had a significant effect at the ($p \leq 0.05$) level in terms of increasing the amount of total yield. As for the rest of the characteristics of the yield components, they are positively and negatively related according to the amount of yield that was harvested, and this relationship is shown in correlation Table 5. These results are consistent with those of Owaid *et al*. [37]. As for the characteristics mentioned in Table 2, regarding the time duration of the production cycle, all treatments exceeded the T1 (S1W0) treatment, this may be due to the continuation of production as shown in Table 2A. The rapid completion of mycelium proliferation was due to the presence of a high percentage of carbohydrates in each from the T1 and T3 treatments, as shown in Table 4. Carbohydrates have a direct role in providing the basic material on which the mushrooms feed. As for mycelium growth in the sawdust substrate for the T5 and T6 treatments, it is slow due to the presence of a high C/N ratio in addition to some tannin compounds inhibiting the spread of mycelium in a short time [38]. As for the characteristics of the formation of pinheads, its short period can be explained by the clumping of the mycelium in specific places in the medium due to the lack of porosity indicated in Table 4. Consequently, the formation of pin-heads and this characteristic is directly reflected with the next characteristic, as shown in correlation Table 5. The period of the *P. eryngii* production cycle decreased because the mushroom stopped producing, while production continued in the rest of the treatments, which in turn was reflected in the amount of yield, as shown in Table B1. As for the number of days of mycelial proliferation, it was found that the shortest duration of mycelial proliferation was in the T3 medium, and the reason is due to the increase in carbohydrates suitable for mycelial growth [38]. As for the number of days for fruiting heads and fruiting bodies, the T3 treatment had a significant effect in reducing this period, which may be due to the completeness of

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the mycelium, which may have a direct or positive correlation, as in correlation Table 6.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

The substrates and co-substrates employed in oyster mushroom production, especially *P. ostreatus* and *P. eryngii*, strongly influence their morpho-growth characteristics. The highest yield for both types of mushrooms was from the sugarcane bagasse medium with the addition of sunflower seed hulls, with P. eryngii showing a clear biological efficiency on this medium. On the basis of these results, this supplemented medium can prove functional as an acceptable substrate supplement for oyster mushroom cultivation. The application of agricultural byproducts, such as sugarcane bagasse and sunflower seed hulls, must be encouraged to maintain the yield and sustainability objectives. Additionally, further research should explore these substrate compositions for obtaining biological efficiency. Commercial growers might alternatively switch to other substrates, both for cost-cutting and to improve production efficiency.

CONFLICT OF INTEREST

All of the authors declare that they have no personal or financial relationships that could potentially influence or bias this manuscript content.

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Table 1: Results of fruiting body yield characteristics for *P. ostreatus* and *P. eryngii*

Table 1A (*P. ostreatus*)

Treatment	Total yield g.kg^{-1}	No. fruiting	No flash	Mean fruiting g.kg^{-1}	Mean flash g.	Bio efficiency %
T1	301.3 a	8.333 a	4.667 a	36.25 a	64.73 bc	90.40 a
T2	119.7 b	3.000 bd	2.000 cd	36.67 a	55.00 c	50.16 bc
T3	307.0 a	8.333 a	3.667 b	37.25 a	84.64 b	87.71 a
T4	171.7 b	5.333 b	2.667 c	32.21 a	64.44 bc	62.70 bc
T5	247.0 a	5.333 bc	2.333 c	46.31 a	108.06 a	70.57 ab
T6	127.4 b	2.667 d	1.333 d	48.42 a	81.50 b	44.19 c
% C. V	18.1	23.1	19.0	28.4	16.8	17.9

Table 1B (*P. eryngii*)

Treatment	Total yield g.kg^{-1}	No. fruiting	No flash	Mean fruiting g.kg^{-1}	Mean flash g.	Bio efficiency %
T1	139.0 b	2.000 a	1.667 ab	69.50 b	90.00 a	41.70bc
T2	94.0 c	1.333 b	1.00 b	70.17 b	94.00 a	39.49 bcd
T3	169.7 a	2.000 a	2.333 a	84.83 b	74.39 a	48.48a
T4	92.0 c	1.000 b	1.00 b	92.00 ab	92.00 a	33.57d
T5	132.7 b	1.000 b	1.333 b	123.00 a	100.33 a	37.80cd
T6	121.3 b	1.333 b	1.333 b	99.83 ab	99.83 a	44.31ab
% C.V	8.8	23.1	32.6	19.9	23.9	8.1

^(C.V.) Coefficient of Variation.

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Table 2: Stages of growth and mycelium run and formation of fruiting bodies of *P. ostreatus* and *P. eryngii*

Table 2A (*P. ost*)

Treatment	Crop cycle day	No. day mycelia	No. day pin	No. day fruit
T1	71.67 c	49.33 ab	8.33 a	7.667 ab
T2	39.67 ab	64.67 cd	13.67 bcd	10.333 c
T3	53.33 b	43.33 a	14.33 cd	9.333 bc
T4	44.33 ab	60.33 bc	13.00 bc	6.667 a
T5	30.00 a	76.00 d	11.33 b	7.667ab
T6	30.00 a	78.00 d	16.00 d	10.667 c
% C.V	19.2	12.1	12.1	13.2

Table 2B (*P. eryngii*)

Treatment	Crop cycle day	No. day mycelia	No. day pin	No. day fruit
T1	24.7 ab	64.00 bc	10.67 ab	8.333 a
T2	9.0 a	108.00 d	21.00 c	12.000 c
T3	40.7 b	32.67 a	7.67 a	7.667 a
T4	42.7 b	82.00 c	13.33 b	9.333 ab
T5	32.7 ab	79.67 c	13.00 b	10.667 bc
T6	28.7 ab	49.00 ab	12.67 b	11.333 c
% C.V	46.5	14.0	14.4	9.8

Table 3: Treatments of the two experiments for *Pleurotus ostreatus* and *Pleurotus eryngii*

	1st experiment *P. ostreatus*			2nd experiment *P. eryngii*	
Treatments	**Substrate type**	**Co-substrates type**	***Treatments***	**Substrate type**	**Co-substrates type**
T1	S1 100%	W0 0%	**T1**	S1 100%	W0 0%
T2	S2 100%	W0 0%	**T2**	S2 100%	W0 0%
T3	S1 80%	W1 20%	**T3**	S1 80%	W1 20%
T4	S2 80%	W1 20%	**T4**	S2 80%	W1 20%
T5	S1 80%	W2 20%	**T5**	S1 80%	W2 20%
T6	S2 80%	W2 20%	**T6**	S2 80%	W2 20%

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Table 4: Laboratory analyses of substrate and co-substrate

Type of medium	% N	% Protein	% Carbohydrates	% Ashes	% Fibre	% O.C	%.O.M	C/N Ratio	% Absorption rate	% Porosity
Sugar cane bagasse	0.637	2.790	8.13	17.8	12.70	47.7	82.2	74.88	170	43.39
Sawdust	0.392	1.716	2.62	2.20	11.83	56.7	97.8	144.6	230	52.20
Sunflower seed hulls	1.152	5.034	40.20	3.650	14.08	55.88	96.35	48.5	90	31.48
Peanut shells	1.38	6.04	53.50	10.50	16.32	51.91	89.5	37.61	130	45.31

^ (N) Nitrogen according to [39]
^ Ashes according to [40]
^(C) Carbon.
^ (O.M) Organic matter =100 - ash %
^ (O.C) Organic Carbon = (O.M) * 0.58
^ Then calculated C: N Ratio [25, 26], [17]

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Table 5: Correlations of *P.ost*

	bioeffiecy	crop_cycle_day	mean_flash	mean_fruit	no_day_fruit	no_day_myceilia	no_day_pin	no flash	no_fruit	total_yeild
Bioeffiecy		0.7115 <0.001	0.17 0.5001	-0.1219 0.63	-0.4276 0.0767	-0.5611 0.0154	-0.5208 0.0267	0.8724 <0.001	0.9357 <0.001	0.9712 <0.001
crop_cycle_day	0.7115 <0.001		-0.34 0.1674	-0.2733 0.2725	-0.2979 0.2298	-0.7279 <0.001	-0.561 0.0154	0.8799 <0.001	0.7162 <0.001	0.6235 0.0057
mean flash	0.17 0.5001	-0.34 0.1674		0.3213 0.1936	-0.1526 0.5455	0.1784 0.4788	0.0179 0.9437	-0.2163 0.3886	0.1319 0.602	0.3158 0.2017
mean fruit	-0.1219 0.63	-0.2733 0.2725	0.3213 0.1936		-0.0382 0.8804	0.1683 0.5043	-0.0425 0.8672	-0.3123 0.2071	-0.3854 0.1143	-0.015 0.9529
no_day_fruit	-0.4276 0.0767	-0.2979 0.2298	-0.1526 0.5455	-0.0382 0.8804		0.2792 0.2619	0.5986 0.0087	-0.3509 0.1534	-0.3763 0.1238	-0.3896 0.11
no_day_myceilia	-0.5611 0.0154	-0.7279 <0.001	0.1784 0.4788	0.1683 0.5043	0.2792 0.2619		0.3989 0.101	-0.6436 0.0039	-0.6137 0.0067	-0.5302 0.0236
no_day_pin	-0.5208 0.0267	-0.561 0.0154	0.0179 0.9437	-0.0425 0.8672	0.5986 0.0087	0.3989 0.101		-0.599 0.0086	-0.4583 0.0558	-0.4996 0.0347
no flash	0.8724 <0.001	0.8799 <0.001	-0.2163 0.3886	-0.3123 0.2071	-0.3509 0.1534	-0.6436 0.0039	-0.599 0.0086		0.8733 <0.001	0.8214 <0.001
no_fruit	0.9357 <0.001	0.7162 <0.001	0.1319 0.602	-0.3854 0.1143	-0.3763 0.1238	-0.6137 0.0067	-0.4583 0.0558	0.8733 <0.001		0.9124 <0.001
total_yeild	0.9712 <0.001	0.6235 0.0057	0.3158 0.2017	-0.015 0.9529	-0.3896 0.11	-0.5302 0.0236	-0.4996 0.0347	0.8214 <0.001	0.9124 <0.001	

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Table 6: Correlations of P.eryngii

	bioeffiecy	crop_cycle_day	mean_flash	mean_fruit	no_day_fruit	no_day_myceilia	no_day_pin	no_flash	no_fruit	total_yeild
Bioeffiecy		-0.0834 0.7422	-0.4469 0.063	-0.1222 0.6291	-0.2623 0.2929	-0.6114 0.007	-0.3862 0.1134	0.7863 <0.001	0.6235 0.0057	0.8036 <0.001
crop_cycle_day	-0.0834 0.7422		-0.281 0.2586	0.2567 0.3038	-0.5692 0.0137	-0.4239 0.0795	-0.6682 0.0024	0.276 0.2677	-0.0477 0.8509	0.1909 0.4479
mean_flash	-0.4469 0.063	-0.281 0.2586		0.2908 0.2418	0.3846 0.115	0.1172 0.6432	0.2205 0.3792	-0.7889 <0.001	-0.4583 0.0558	-0.3959 0.1039
mean_fruit	-0.1222 0.6291	0.2567 0.3038	0.2908 0.2418		0.2306 0.3572	-0.0182 0.943	-0.1147 0.6505	-0.0913 0.7186	-0.6855 0.0017	0.0841 0.7402
no_day_fruit	-0.2623 0.2929	-0.5692 0.0137	0.3846 0.115	0.2306 0.3572		0.5338 0.0225	0.8105 <0.001	-0.586 0.0106	-0.5787 0.0119	-0.5653 0.0145
no_day_myceilia	-0.6114 0.007	-0.4239 0.0795	0.1172 0.6432	-0.0182 0.943	0.5338 0.0225		0.8562 <0.001	-0.533 0.0227	-0.48 0.0438	-0.7179 <0.001
no_day_pin	-0.3862 0.1134	-0.6682 0.0024	0.2205 0.3792	-0.1147 0.6505	0.8105 <0.001	0.8562 <0.001		-0.589 0.0101	-0.4249 0.0788	-0.7097 <0.001
no_flash	0.7863 <0.001	0.276 0.2677	-0.7889 <0.001	-0.0913 0.7186	-0.586o 0.0106	-0.533 0.0227	-0.589 0.0101		0.6436 0.004	0.8465 <0.001
no_fruit	0.6235 0.0057	-0.0477 0.8509	-0.4583 0.0558	-0.6855 0.0017	-0.5787 0.0119	-0.48 0.0438	-0.4249 0.0788	0.6436 0.004		0.6002 0.0085
total_yeild	0.8036 <0.001	0.1909 0.4479	-0.3959 0.1039	0.0841 0.7402	-0.5653 0.0145	-0.7179 <0.001	-0.7097 <0.001	0.8465 <0.001	0.6002 0.0085	

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