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Production of Red Chilli (*Capsicum annum* L.) Hybrid Seed, Curmiyeast Concentrate, and Compost Based on Dairy Farm Waste

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ABSTRACT: This experiment aimed to produce hybrid red chilli seeds, Curmiyeast- concentrate, and Bokashi compost based on a dairy farm. Red chilli G 3 and G 7 were used as parent stocks in preparing UNIB C H73 hybrid. The recommended time for crossing the red chilli was around 06.00-10.30 in the morning. The ingredients of Curmiyeast- concentrate were rice brand, ground corn, soybean meal, palm oil, mineral mix, salt, and urea. At the same time, *Curcuma xanthorrhiza* and yeast were 2 and 1%, respectively, in a total of 100%. Curmiyeast- concentrate in this modified formula contained 15.22% crude protein, with the price of Rp. 8,515/kg and MIOFC of Rp. 78,470/head/day or Rp. 9,019/l of milk produced. Bokashi compost contained N, P, K, and C organic and a ratio of C/N (18.9) that fulfilled the standards of SNI 19-7030-2004.

Keywords: Bokashi compost, Curmiyeast- concentrate, red chilli

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INTRODUCTION

Selupu Rejang subdistrict, Rejang Lebong district, Bengkulu, is a centre for dairy farming. This location is 1000-1200 m above sea level with a temperature of around 18-26^{o}C. This condition is a comfortable place to live for dairy cows, fulfilling the thermoneutral zone. Apart from that, this location is also a centre for vegetable crops, including chillies. Curly chilli varieties certified by the Ministry of Agriculture, the result of research from University of Bengkulu, must be introduced in this area. The national chili production in 2021 is 1,360. Five hundred seventy tons, while consumption was 596,140 tons (BPS, 2022).

Meanwhile, dairy farms in this area generally do not implement concentrate feeding, so cow milk production is relatively low (5-8 l/cow/day). Dairy farm waste can also be used as compost. However, integration between dairy farming and horticultural crops such as chillies could be a source of economic drive in this area. The integration of these two agricultural activities synergizes by providing local concentrates to dairy cows other than those that produce milk. It also produces feces that can be processed into compost and used as organic fertilizer for vegetable plants, such as curly chillies.

Curly chillies or *Capsicum annum* are the most widely cultivated and crossed. From the research results, several varieties have been produced that have received PVP certificates from the Ministry of Agriculture, namely UNIB C H13. (341/PVHP/2015), UNIB C 23 (340/PVHP/2015), Dwiguna UNIB (339/PVHP/2015), UNIB C H73 (342/PVHP/2015) (Ganefianti, 2021 and Ganefianti et al., 2019). These varieties resist Begomovirus disease (yellow leaf curl) and produce around 10 tons per hectare.

Begomovirus infection causes different symptoms in several chilli genotypes (Ganefianti et al., 2017). Five typical symptoms occur in plants infected with Begomovirus, namely 1= yellow leaf, 2= yellow and curly leaves, 3= yellow leaves, curly curling down or up, 4= yellow curly leaves curling down and up and 5= yellow, curly leaves curve downwards and upwards, and the plant becomes stunted. Based on the type of symptoms of chilli plants due to Begomovirus infection, the five symptoms are then given a score of 0-5, namely no symptoms score 0, yellow symptoms score 1, symptoms of yellow and curly leaves score 2, symptoms of yellow leaves, curling and curling downwards or upwards score 3, symptoms of yellow leaves curling downwards and upwards score four and symptoms of yellow leaves curling downwards and upwards and stunted plants score 5 (Ganefianti, 2021). Many genes control chilli resistance to Begomovirus infection, and there are extrachromosomal effects in the IPBC12X35C2 cross population. However, the other three populations showed no extrachromosomal effects (Ganefianti, 2021).

Curmiyeast concentrate is made from rice bran, corn, soybeans, palm oil, mineral mix, salt and supplements *Curuma xanthorriza* or Temulawak and yeast. This concentrate is prepared based on a modified formula from previous research, modified by Sulistyowati et al. (2015) and Sulistyowati et al. (2021).

Compost is an organic material (organic waste) that has undergone a weathering process due to interactions between microorganisms (rotting bacteria) that work in it. Cow dung is a material that has the potential to be used as compost. Cow manure contains nutrients, including 0.33% nitrogen, 0.11% phosphorus, 0.13% potassium, and 0.26% calcium. Compost is the best and most natural soil amendment rather than artificial/synthetic fertilizer. Organic fertilisers generally contain low N, P and K macronutrients, including chillies, but contain sufficient micronutrients necessary for plant growth. Therefore, applying these technologies, such as hybrid red chilli, Curmiyeast concentrate, and compost based on dairy farming, was crucial.

MATERIALS AND METHODS

Preparation of Hybrid Red Chilli

The implementation of chilli crossing is as follows: the chilli plants as parents are G7 and G3 in the following picture. Plants were sown in potrays after four weeks of age and transferred to polybags measuring 50 x 50 cm^2.

Fig. 1. Red chilli is used as parent stocks in preparing UNIB C H73 hybrid

Plants begin to flower around 10 to 20 days after transplanting; crossing can occur every morning from 6.00 – 10.30 WIB. The procedure for crossing is as follows (1) Select a flower that is expected to bloom tomorrow, with the characteristics of the flower crown being fully swollen. (2) The crown is pulled slowly until it is clean using tweezers. (3)

Clean the flowers from the stamens using tweezers so that only the stigma remains. (4) Hang the label on the flower with only the pistil remaining. (5) Choose as a source male flowers flowers that have bloomed fresh or whose pollen sacs have broken. (6) Collect the flowers in a petri dish or take the flowers directly to the female flowers, which are ready to be pollinated. (7) Brush the pistils with pollen from the prepared flowers. (8) The cross label contains the name of the parent being crossed, the cross's date and the cross's name. (9) The crossing was successful Three days after the crossing if the flowers did not fall and remained green.

Preparation of Curmiyeast Concentrate

Preparing *Curcuma xanthorriza* flour starts with washing the ginger rhizomes, slicing them thinly, drying them in the sun, and grinding them into flour. Make yeast or yeast tape using 1 kg rice flour, 50 g grated Galanga, two cloves of finely ground garlic, 100 g of grated cassava, one lime juice, 10 g of granulated sugar, and 1 litre of boiled water. All ingredients are mixed into a dough, then molded into rounds of around ten g/piece, and then dried in the sun (Pusbangtepa, 1980). Concentrate preparation follows the following formula.

Table 1. Concentrate containing *Curcuma xanthorrhiza* and *yeast*

Ingredients	Composition (%)
Rice brand	45
Ground corn	25
Soybean meal	20
Palm oil	4
Mineral mix	1.0
Salt	1.0
Urea	1.0
Yeast	1.0
Curcuma xanthorrhiza	2
Total	100

Source: modified from Sulistyowati et al. (2015), Sulistyowati et al. (2019), and Sulistyowati et al. (2021).

Each ingredient is weighed and mixed, starting from the largest ingredient to the smallest and mixing until homogeneous.

Preparation of Compost Based on Dairy Farm Waste

The ingredients consist of 1000 kg cow dung, 250 kg rice brands or green leaves, 3 litres of molasses, enough water to make it moist, and 3 litres of decomposer (EM4). The tools needed are a hoe and shovel to stir the compost material and turn it over. Plastic to cover the compost mixture is placed in a shady place from sunlight and rain. The compost-making process is divided into four parts. Part 1 is the mixing process, part 2 is one old mix, part 3 is a 2-week-old mix, and part 4 is finished compost and compost packaging. Two buckets for taking water and diluting the molasses. Sacks for packaging compost.

Compost material is prepared from cow dung below and leaves or straw on top. Sprinkle EM4 evenly. Molasses are diluted and sprinkled evenly over the mixture. Stir the compost material until smooth. Set the humidity to 60% so that when you hold it, it doesn't break, there are no water droplets, and your hands are not wet. If it is not damp enough, add enough water. The mixed material is covered with plastic. Reversal is done every week. Checking the composting process is carried out on the third day. If it feels hot, then the composting process occurs. The composting process lasts for three weeks. After three weeks, the compost is ready, characterized by the compost material not being hot and not smelly. Testing for the nutrients N, P, K, and Ca was carried out. Compost is ready to be applied to curly chilli plants and other plants.

The characteristics of finished and good compost are that the color of the compost is blackish brown, and the aroma of good compost is not strong but gives off an aroma like the smell of earth or forest humus. If held and clenched, the compost

will clump. When pressed gently, the compost clumps will crumble easily.

RESULTS AND DISCUSSION

Production of Red Chilli Hybrid

These pictures are the steps of crossing the red chilli to produce a red chilli hybrid. Crossing the plants is recommended during the early morning, around 04.00-07.00, when the temperature is still low enough to conduct this procedure, as Andayani and Maharani (2021) reported.

Farmers' respondents generally do not know hybrid chillies (62.5%) and cannot differentiate between hybrid and non-hybrid seeds. 38% of farmer respondents are familiar with hybrids and can differentiate them from non-hybrid seeds. Some farmers use hybrid seeds (50%), and some from previous harvests (50%). More farmers want to make their hybrids (75%) than do not (25%) and say this knowledge is 100% important to them.

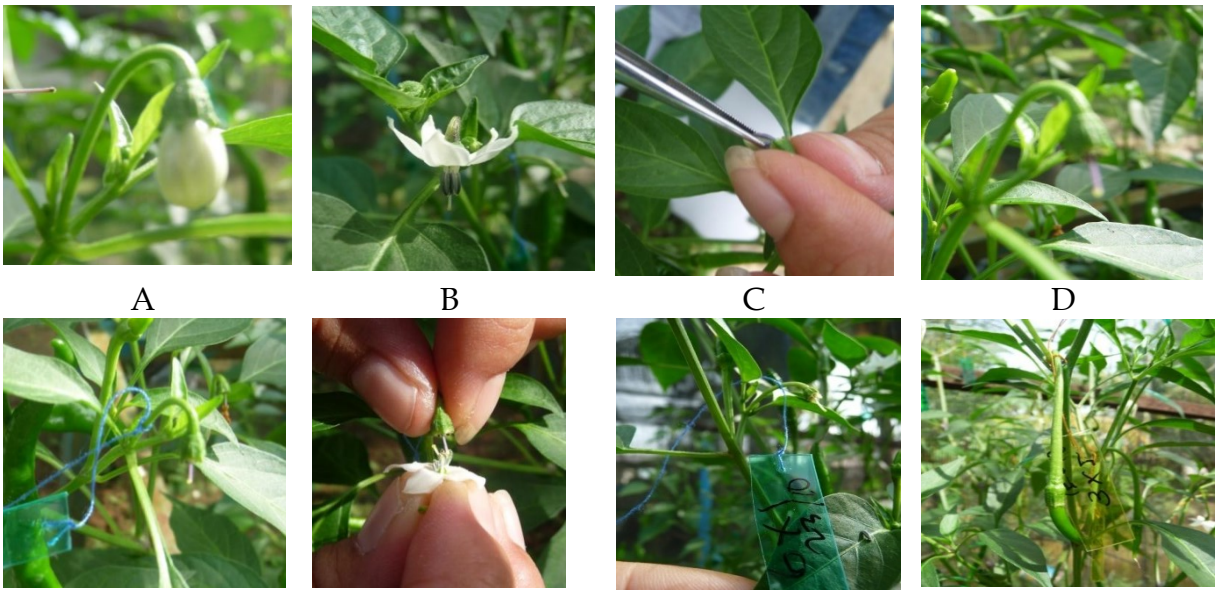

Fig. 2. (A) Female chilli flowers ready to be castrated (B) Freshly blooming male flowers as a source of males (C) Pull out the flower crown then clean the stamens (D) Female flowers that have been castrated (E) Hang a label (F) Pollen the pistils with a mature male (G)) the label contains the name of the parent being crossed, the date of the cross and the name of the cross (H) Fruit that has been crossed. Not all farmers can make hybrids (100%), so this knowledge benefits them.

Production of Curmiyeast Concentrate

The ingredients of Curmiyeast concentrate are as follows in fig. 3.

Fig. 3. The ingredients and the making of Curmiyeast concentrate.

The results of the proximate nutritional test of Curmiyeast concentrate are presented in the following table.

Table 2. Nutrient content of Curmiyeast concentrate

Content	Composition (%)
Dry Matter	88.75
Organic Matter	79.06
Ether extract	10.45
Crude protein	15.22
Crude fiber	12.83

Note: IPB -PAU Laboratory (2023)

Crude protein requirements for lactating dairy cows are 12-14%, according to NRC (1989). Therefore, Curmiyeast concentrate is sufficient for crude protein (15.22%). The PUFA-concentrate with 0.5% or 5 g yeast and 2% or 20 g Curcuma powder was considered nutritionally sound for dairy goats (Sulistyowati et al., 2015). Concentrate with 1% *Curcuma xanthorrhiza,* 1% yeast, 5% fermented *Durio zibethinus* peel flour and 25% rice bran was considered optimal for lactating dairy goat (Sulistyowati et al., 2021). In lactating dairy cows, 0.5% yeast and 2% *Curcuma xanthorrhiza* in concentrate containing 27.5% Durio seed meal are considered optimal in nutrient digestibility and milk production (Sulistyowati et al., 2019).

This concentrate is given at around 2-3 kg/head/day, considering the concentrate's economic value and milk production costs. In this way, we can calculate Milk Income Over Feed Cost (MIOFC)= (milk production x milk price/l)-((forage intake x forage price) + (tofu dregs intake x tofu dregs price) + (Ingredients concentrate consumption x Curmiyeast concentrate price/kg). It is a price list of some ingredients included in the concentrate.

Table 3. Pricing of Curmiyeast concentrate

Ingredients	Composition (%)	Price (Rp/kg ingredient)	Price (Rp/kg concentrate)
Rice brand	45	3,500	1,575
Ground corn	25	7,000	1,750
Soybean meal	20	13,000	2,600
Palm oil	4	15,000	600
Mineral mix	1	13,000	130
Salt	1	15,000	150
Urea	1	11,000	110
Yeast	1	40,000	400
Curcuma	2	60,000	1200
Total	100		8515

The average milk production of dairy cows during observations was around 8.7 l/day (price Rp 15,000/l), with fresh forage consumption around 25 kg/bundle/cow/day (price Rp 20,000/bundle, fresh tofu dregs 25 kg/sack/head /day (price Rp. 15,000/sack) and Concentrate- Curmiyeast 2 kg/head/day (price Rp. 8,515/kg). So, the calculation of Milk Income Over Feed Cost (MIOFC) = (8.7 x Rp. 15,000/ l) – ((1 x Rp. 20,000/bundle) + (1x Rp. 15,000/sack) + (2 kg x Rp. 8,515/kg)) = Rp.130,000/head/day – Rp. 52,030/head/day = Rp. 78,470/head/day. So, if MIOFC is calculated based on milk production, it comes to Rp. 9,019/l.

Production of Compost Based on Dairy Farm Waste

These are some steps in producing bokashi compost.

Fig. 4. The making of compost based on dairy farm waste

The nutritional content of the Bokashi compost that has been made is presented in the table as follows. The recommendation for composting is with a ratio of C/N 16 containing dairy cow feces and Kirinyuh leaves in a ratio of 1:1 (Safari et al., 2023).

Table 4. Nutrient contents of organic compost

Content	Composition
N total (%)	1.54
P (%)	0.94
K (%)	1.25
C-organic (%)	29.22
Ratio C/N	18.97

Note: UNIB- Soil Science Laboratory (2023)

These results showed higher N, P, and K contents than research results reported by Hidayat et al. (2023). Their results showed Nitrogen (1.47%), Phosphorus (0.38%), and Potassium (0.28%) with a C/N ratio of 19.08 in compost consisting of cow manure rice straw with marine organic waste. The composition of the compost affects the different mineral contents and C/N ratios in compost. According to SNI 19-7030-2004, mature compost has a C/N ratio of 10-20. Therefore, our C/N (18.97) ratio fulfilled this standard.

The basic knowledge about making compost, which includes materials, the function of EM4, the activator solution material, the turning time in the process of making bokashi compost, mixing the bio activator solution into the pile of bokashi material, and the use of other materials (such as straw) for bokashi compost material from breeders is still relatively low (around 51%). After the bokashi compost production process was applied, their knowledge increased (97%).

CONCLUSION

Red chilli crossing is vital in producing seeds and can be carried out in the morning around 06.00-10.00. Red chilli G 3 and G 7 were used as parent stocks in preparing the UNIB C H73 hybrid. Curmiyeast- concentrate in this modified formula contained 15.22% crude protein, with the price of Rp. 8,515/kg and MIOFC of Rp. 78,470/head/day or Rp. 9,019/l of milk produced. Bokashi compost contained N, P, K, and C organic and a ratio of C/N that fulfils the standards of SNI 19-7030-2004.

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