Study of technology packages to support increasing production of chili pepper commodities in South Sulawesi

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Abstract. The purpose of the study is to obtain packages of chili pepper cultivation technology to support the increasing productivity of chili pepper in South Sulawesi. The study was held in Lengkese village, Mangarabombang District, Takalar Regency, South Sulawesi, Indonesia, from April to August 2019. The experimental design used Randomized Block Design, with three replications and five treatments: A = Maruti variety, closed nursery, black silver plastic mulch (BSPM), plant distancing 75 cm x 60 cm, a dosage of solid organic fertilizer 20 tons/ha, and 180 N, P, K kg/ha of inorganic fertilizers; B = Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 60 cm, a dosage of solid organic fertilizer 10 tons/ha and 135 N, P, K kg/ha of inorganic fertilizers; C = Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 10 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers; D = Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 20 tons/ha and 135 N, P, K kg/ha of inorganic fertilizers; and E= Maruti variety, open nursery, plant distancing 75 cm x 30 cm and dosage of inorganic fertilizers 127 N, 60 P, 60 K kg/ha. The results showed that C treatment used the technology packages: Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 10 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers produced more chili pepper weights per plant. The height of A and D treatment was significantly different from E treatment and resulted in the highest production of chili pepper, 14.97 tons/ha. Organisms such as *Myzus persicae*, fruit flies, *Fusarium* wilt disease, and anthracnose were found in low infestation rates. The technology packages can use to support the increasing production of chili pepper in South Sulawesi.

1. Introduction

From 2015 until 2019, chili pepper is a strategic horticultural commodity besides shallots and oranges on agricultural development. The supply of chili pepper continues to increase based needs of the community and industry. According to Yanuarti AP and Afsari (2016), the need for red chilies per capita is in the range of 3.06 kg/capita/year [1]. If the total population of Indonesia is 265 million, it will take annually about 810,900 tons. Chili pepper is an important commodity with high production and price fluctuations, where the fluctuation in production and price is one of the causes of inflation in Indonesia [2].

In 2016, the chili pepper planting areas in South Sulawesi about 8.267 ha with a low productivity level of 6.67 tons/ha [3]. At the national level, the productivity of chili pepper under 6 tons/ha on average, and yields vary between dry and rainy seasons [4-6]. This productivity is still far from its potential production of above 10 tons/ha for pure strain varieties and more than 24 tons/ha for hybrid...
varieties [5,7-9]. Increasing the planting area is the one strategy to increase the production of chili pepper [6]. However, this is relatively difficult to do in limited agricultural land covering the needs of the other commodities. Another alternative to increasing chili pepper production is increasing the productivity of agricultural land with support factors increasing the crop productivity [10].

The optimize and application of chili pepper cultivation technology is one of the main problems causing the low productivity of chili pepper at the farm level [4]. According to Puspitasari et al. (2019) apart from the variety used, several other technical factors are giving impact to the harvest of chili pepper [2]. If the technical factors are not handled properly, they have the potential to become a limiting factor increasing chili pepper production. Some of the important technical factors including the use of chemical fertilizers and growth substances [11], production factors such as land, seeds, fertilizers, pesticides, labor and technology [12,13] and factors caused damage of plant namely: pests, diseases and weeds [14,15]. Based on this fact, it is very important to pay attention to improvement in the application of cultivation technology aimed at optimizing the production factors and increasing the productivity of chili pepper.

The Center for Horticultural Research and Development, the Agricultural Research and Development Agency through the Vegetable Crops Research Institute has played a role in producing the red chili cultivation technology, ranging from seedling, plant breeding, use of high-quality seeds, healthy nurseries, planting patterns, plant distancing, nutrient management, and water, intensive crop maintenance, post-harvest handling, control the development of pest and plant disease.

Several studies related to the technology have been carried out, and the results have contributed significantly to the increase in chili production, especially chili pepper. According to Sumarni N and Muhamad A (2005), the quality seeds of superior varieties are one of the factors that trigger the productivity of chili pepper [16,17]. The use of superior varieties of chili pepper showed that the chili variety Tanjung-2 had been planted by farmers in areas more than 600 ha spread across Tasikmalaya, Garut, Majalengka, Cirebon, Indramayu, Sumedang, and Cianjur districts [8]. The adoption of variety Tanjung-2 in Ciamis can increase farmers’ profit by about 52.9 million IDR per hectare. The varieties such as Kencana, Lingga, PM 99, and Megatop are the varieties that easy to adopt and provide high production in the Banyuresmi district [2]. Lingga is a chili pepper variety showing high production and the most popular variety using in West Sulawesi [18].

Healthy nurseries have the purpose of producing healthy seeds. This is a very important factor in the cultivation of chili pepper. If the chili pepper plant has been attacked by a virus since in the nursery, the mortality rates of chili pepper seeds can reach 100%. The plant density or distancing between plants will affect the plant population and the efficiency of the use of sunlight, as well as competition between plants in using water, nutrients, and growth space. The optimum plant distancing for chili pepper ranges from (50-60 cm) x (40-50 cm). The results showed that planting used distancing less than 50 cm x 50 cm caused a significant decrease in the yield of chili pepper [16].

The use of mulch in planting red chilies is one effort to provide a better environmental condition for plant growth and produce optimally. The silver color in black plastic mulch has the ability to reduce the heat temperature into the soil and to reduce the evaporation of groundwater. The increasing solar radiation will increase the photosynthesis process in plants and reduce humidity in the planting environment to avoid disease progression. Mulching can improve soil air conditioning and increase soil pores. The microorganism activity can be better and ensure water availability for plants [2]. The research result Soetiarso TA et al. (2006) showed that the use of black silver plastic mulch could significantly increase the number of healthy fruits per plant, healthy fruit weight per plant, and healthy fruit weight per plot [14]. It was further reported that the use of black silver plastic mulch could reduce the damage to red pepper plants to anthracnose, thrips, mites and delay the incidence of viruses.

The availability of sufficient and balanced macronutrients (N, P, K, Ca, Mg and S) or micronutrients (Zn, Fe, Mn, Co, and Mo) in the soil is an important factor in getting high-quality chili pepper yields. Each nutrient has a specific role in the plant. The need for fertilizer for planting chili pepper varies, depending on the cultivar, type of land, location, planting season, and the type of fertilizer used. According to Lologau BA et al. (2018) reported that technically use of black silver
plastic mulch and fertilizer dosage (150 kg N/ha + 150 kg P2O5/ha + 150 kg K2O/ha) provide high chili production (147.36 kg per 220 m²) and efficient use of fertilizers [19]. The purpose of the study is to obtain packages of chili pepper cultivation technology to support the increasing productivity of chili pepper in South Sulawesi.

2. Methodology
The study on chili pepper was held from April to July 2019 in rainfed rice fields in Lengkese village, Mangarabombang District, Takalar Regency, South Sulawesi. Materials used in the study are chili pepper seeds, bamboo, soil, water, polybags, black silver plastic mulch (BSPM), pesticides, organic and inorganic fertilizers. The tools used are a scale, hoe, measuring tools, and hand sprayer.

The study used a Randomized Block Design with five treatments and three replications. The number of treatments used 15 plots, with an area of each plot treatment measure 8 m x 6 m. The five treatment packages were:

| Technology Components | Treatment |
|-----------------------|-----------|
| 1. Varieties          | Maruti    |
| 2. The nursery condition | Closed   |
| 3. Black silver plastic mulch (BSPM) | BSPM |
| 4. Plant distancing | 75 cm x 60 cm |
| 5. Dosage of solid organic fertilizers | 20 ton/ha |
| 6. Dosage of the inorganic fertilizers | 180 N, P, K kg/ha |

Chili pepper seeds were sown on a medium containing a mixture of soil and organic fertilizer (compost) with a ratio of 2:1 filled in polybags. The seeds of the chili pepper soaked in warm water for one hour, then put the seeds in polybags. After the chili pepper seeds age 35 days after planting (5 - 6 leaves), the seeds were then transferred to the prepared treatment plots. Fertilization used solid organic and inorganic fertilizers according to the treatment. Plant maintenance was adapted to planting conditions.

The parameters observed were: 1) plant vegetative growth, 2) population and intensity of pests and major diseases of chili pepper, and 3) yield components of chili pepper production. The observations of plant vegetative growth, such as plant height, canopy width, and stem diameter, were carried out at the age of 120 days after planting (DAP). The yield components (fruit length, fruit diameter, fruit weight, and crop production per plot) were observed at harvest time. The observations used ten plant samples in every treatment plot. The observation of the insect pest population was calculated based in-situ technique in the plant samples. The intensity of main pests and diseases of leaves-destroying chili pepper plants was calculated used the formula [20]:

| Technology Components | Treatment |
|-----------------------|-----------|
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\[ I = \sum (n \times v) / Z \times N \times 100\% \]  

\( I \) = The intensity of plant damages;  
\( n \) = The number of plants has the same damages category;  
\( v \) = The category value:  
\( 0 \) = plants are not attacked (healthy plant)  
\( 1 \) = < 20\% leaves area attacked  
\( 3 \) = >20\% - 40\% leaves area attacked  
\( 5 \) = >40\% - 60\% leaves area attacked  
\( 7 \) = >60\% - 80\% leaves area attacked  
\( 9 \) = >80\% leaves area attacked  
\( Z \) = The highest attacked category value  
\( N \) = The number of plants observed  

The calculation the intensity of pests and diseases attacked chili pepper fruits based the formula:

\[ I = \frac{\text{The number of fruits affected}}{\text{The number of fruits observed}} \times 100\% \]  

The data on vegetative growth, chili pepper production, the intensity of pest and disease attacks were analyzed variance used the F test. Differences in the effect of treatment used Duncan’s Multiple Range Test at the \( \alpha = 5\% \).

3. Result and discussion

3.1. Vegetative growth of chili pepper plants

The results analysis of variance in the vegetative growth of chili pepper showed not a significant difference. This showed that statistical data for the five technology packages have the same effect on the growth of chili pepper plants. The growth of chili pepper tends to be better in the technology package used treatment A based on the parameters of plant height (68.87 cm), stem diameter (1.38 cm) (table 1). The parameters of leaf length (6.27 cm) and leaf width (2.90 cm) (table 2) were higher than treatments B, C, D, and E. The highest canopy width was treatment B, about 57.02 cm. Treatment E was showed lower growth than treatments A, B, C, and D. This was presumably because, in treatment E, chili pepper seeds were sown in the open areas, the plants were not given organic fertilizers and without black silver plastic mulch (BSPM). The application of closed nursery technology or using a cover can prevent optimal viral infections in chili pepper seedlings. The use of BSPM and organic fertilizers also an important technology component for increasing the growth of chili pepper. The Vegetable Crops Research Institute (BALITSA) contributing the two technology components in the technology packages to obtain a double production (Proliga) of chili pepper. The averages of plant height, canopy width, and stem diameter of Maruti chili pepper variety aged 120 days after planting (DAP) in every treatment were showed in table 2.

Table 2. The averages of plant height, canopy width, and stem diameter of maruti chili pepper variety aged 120 days after planting in every treatment.

| Treatment | Plant height | Canopy width | Stem diameter |
|-----------|--------------|--------------|---------------|
| A         | 68.87 a      | 54.93 a      | 1.38 A        |
| B         | 67.80 a      | 57.02 a      | 1.35 A        |
| C         | 65.90 a      | 53.75 a      | 1.35 A        |
| D         | 67.10 a      | 54.20 a      | 1.30 A        |
The averages length and width leaves of the Maruti chili pepper variety aged 90 days after planting (DAP) for each treatment are presented in table 3.

**Table 3.** The averages length and width leaves of the maruti chili pepper variety aged 90 days after planting for each treatment.

| Treatment | Leaf length | Leaf width |
|-----------|-------------|------------|
| A         | 6.27 A      | 2.90 a     |
| B         | 5.83 A      | 2.63 a     |
| C         | 5.97 A      | 2.63 a     |
| D         | 5.67 A      | 2.50 a     |
| E         | 5.83 A      | 2.80 a     |

**Notes:** (A) Maruti variety, closed nursery, black silver plastic mulch (BSPM), plant distancing 75 cm x 60 cm, a dosage of solid organic fertilizer 20 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers; (B) Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 60 cm, a dosage of solid organic fertilizer 10 tons/ha and 135 N, P, K kg/ha of inorganic fertilizers; (C) Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 10 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers; (D) Maruti variety, closed nursery, BSPM, the plant was distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 20 tons/ha and 135 N, P, K kg/ha of inorganic fertilizers; and (E) Maruti variety, open nursery, plant distancing 75 cm x 30 cm and dosage of inorganic fertilizers 127 N, 60 P, 60 K kg/ha.

3.2. **Chili pepper production**

The analysis of variance showed that the five treatment packages not significant effect on the length and diameter of the component of fruit, the weight of 100 fruit, and the production of chili pepper per plot. The treatments showed a significant effect on fruit weight per plant. The results of these components were presented in table 3, and table 4 explained the technology packages in treatment A, B, C and D showed a higher average than treatment E. Treatment A showed a higher average fruit length (4.26 cm), fruit diameter wider in treatment D (0.85 cm) (table 4). The average weight of 100 fruit was higher in treatment B (162.0 g). The fruit weight was higher in treatments B and C (401.57 g and 309.53 g), significantly different from treatments A, D, and E. The length and diameter of Maruti chili pepper variety used in each treatment were presented in table 4.

**Table 4.** The length and diameter of maruti chili pepper variety used in each treatment.

| Treatment | Fruit length | Fruit diameter |
|-----------|--------------|----------------|
| A         | 4.26 A       | 0.83 A         |
| Coefficient of Diversity (%) | 9.74 | 4.24 |

Notes: (A) Maruti variety, closed nursery, black silver plastic mulch (BSPM), plant distancing 75 cm x 60 cm, a dosage of solid organic fertilizer 20 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers; (B) Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 60 cm, a dosage of solid organic fertilizer 10 tons/ha and 135 N, P, K kg/ha of inorganic fertilizers; (C) Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 10 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers; (D) Maruti variety, closed nursery, BSPM, the plant was distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 20 tons/ha and 135 N, P, K kg/ha of inorganic fertilizers; and (E) Maruti variety, open nursery, plant distancing 75 cm x 30 cm and dosage of inorganic fertilizers 127 N, 60 P, 60 K kg/ha.

The weight of 100 chili pepper fruit, the fruit weight per plant, and chili pepper production used Maruti variety for each treatment was presented in table 5.

**Table 5.** The weight of 100 chili pepper fruit, the fruit weight per plant, and chili pepper production used maruti variety for each treatment.

| Treatment | Weight of 100 pieces | Fruit weight per plant | Production |
|-----------|----------------------|------------------------|------------|
|           | …… g ……              | …… g ……                | …… t/ha …… |
| A         | 158.67 A             | 304.67 b               | 13.36 a    |
| B         | 162.00 a             | 401.57 a               | 12.89 a    |
| C         | 159.33 a             | 309.53 a               | 14.97 a    |
| D         | 153.33 a             | 287.83 b               | 13.29 a    |
| E         | 147.33 a             | 200.43 c               | 11.64 a    |

Notes: (A) Maruti variety, closed nursery, black silver plastic mulch (BSPM), plant distancing 75 cm x 60 cm, a dosage of solid organic fertilizer 20 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers; (B) Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 60 cm, a dosage of solid organic fertilizer 10 tons/ha and 135 N, P, K kg/ha of inorganic fertilizers; (C) Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 10 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers; (D) Maruti variety, closed nursery, BSPM, the plant was distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 20 tons/ha and 135 N, P, K kg/ha of inorganic fertilizers; and (E) Maruti variety, open nursery, plant distancing 75 cm x 30 cm and dosage of inorganic fertilizers 127 N, 60 P, 60 K kg/ha.

Based on table 5, the treatment E (technology package without mulch and organic fertilizers) showed the lowest average for all components of growth and yield observed, as well as the production achieved was lower than treatments A, B, C, and D. This indicates that the user of mulch and addition organic fertilizers very essential for chili pepper growth and production. In the cultivation of red chilies, the use of organic fertilizers such as manure or compost is a basic requirement, apart from the use of artificial fertilizers (inorganic). The organic fertilizers or compost, apart from supplying nutrients for plants (especially micronutrients) can improve soil structure, maintain soil moisture, reduce nutrient leaching, and increase soil biological activities. The needs manure for red chili plants generally ranges from 20-30 tons/ha in the highland and 15-20 tons/ha on alluvial soil in the lowland [16]. Several studies have shown that the use of organic fertilizers has been shown to increase chili production [21-23].

The use of mulch in planting red chilies is an effort to provide a better environmental condition for plant growth. The plants can grow and produce optimally. The presence of mulch on the soil
surface can preserve the soil structure, maintain soil moisture and temperature, reduce nutrient leaching, suppressing weeds, and reduce soil erosion. According to [24] the use of plastic mulch can increase the activity of microorganisms, thereby contributing to plant growth and yield by increasing the concentration of carbon dioxide in the planting zone. The results of several studies indicated that the use of black silver plastic mulch (BSPM) increased the harvest of some vegetable crops such as red chilies [24,25]. The result of research Aditya A et al. (2013) showed that the use of black and silver plastic mulch had a higher number of fruits and chili productivity per plot compared to the use of mulch made from rice straw and without mulch [26]. According to Puspitasari et al. (2019), the silver color in the mulch is able to reflect light. Presence of the light can suppress the growth of aphids [2].

3.3. Pest and disease attacks on chili pepper plants

The important pests found during the experiment were leaf-sucking insects (Myzus persicae) at 60 days after planting and fruit flies (Dacus dorsalis) at 90 days after planting. The attack intensity of M. persicae and fruit flies in chili pepper was very low, ranging from 0.00 - 1.00 and 0.00 - 0.40%, respectively (table 6). Based on the analysis of variance, it appears that all treatments showed that the level of pest attacks is not significantly different. This indicates that the Maruti variety tends to be resistant to attack by aphids and fruit flies. According to Soetiarso TA et al. (2010) reported that the Hot Chili variety was more able to suppress the whitefly (B. tabaci) population than the Tanjung-2 variety, whereas the Tanjung-2 variety seemed to be relatively able to suppress the attack of the aphids (M. persicae) compared to the Hot Chili variety [4].

_Fusarium_ wilt disease (caused by pathogenic fungi _Fusarium oxysporum_) was found to attack chili pepper plants at the age of 60 and 90 days after planting (DAP), anthracnose disease (_Colletotrichum capsici_) at 120 days after planting. The intensity of _Fusarium_ wilt disease at 90 days after planting and anthracnose at 120 days after planting were only 0.00 - 4.00% and 0.20 - 0.60%, respectively (table 7). According to Soetiarso TA et al. (2010), these two diseases mostly attack chili pepper plants in the generative and harvest phases [4]. Reducing the level of attack by plant pests such as thrips, anthracnose, fruit flies, and fruit borer by 18.10% and 23.93% and improving yield components can increase the productivity of chilies by 54.53% [27]. The averages attack intensity of _M. persicae_ and fruit flies in each treatment is presented in table 6.

Table 6. The averages attack intensity of _M. persicae_ and fruit flies in each treatment used Maruti variety.

| Treatment | Attack Intensity | M. persicae on 60 DAP | Fruit Fly on 90 DAP |
|-----------|-----------------|----------------------|---------------------|
| A         |                 | 0.33 A               | 0.00 A              |
| B         |                 | 0.33 A               | 0.00 A              |
| C         |                 | 0.00 A               | 0.27 A              |
| D         |                 | 0.00 A               | 0.13 A              |
| E         |                 | 1.00 A               | 0.40 A              |

Coefficient of Diversity (%) 18.20 13.98

Notes: (A) Maruti variety, closed nursery, black silver plastic mulch (BSPM), plant distancing 75 cm x 60 cm, a dosage of solid organic fertilizer 20 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers; (B) Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 60 cm, a dosage of solid organic fertilizer 10 tons/ha and 135 N, P, K kg/ha of inorganic fertilizers; (C) Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 10 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers; (D) Maruti variety, closed nursery, BSPM, the plant was distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 20 tons/ha and 135 N, P, K kg/ha of inorganic fertilizers; and (E) Maruti variety, open nursery, plant distancing 75 cm x 30 cm and dosage of inorganic fertilizers 127 N, 60 P, 60 K kg/ha.
The averages intensity of *Fusarium* wilt and anthracnose attacks in each treatment used Maruti variety was presented in Table 7. The averages attack intensity of *fusarium* wilt and anthracnose attacks in each treatment used maruti variety.

**Table 7.** The averages attack intensity of *fusarium* wilt and anthracnose attacks in each treatment used maruti variety.  

| Treatment | Attacks Intensity |  
|-----------|-------------------|  
|           | *Fusarium* wilt in | *Fusarium* wilt in | Anthracnose in |  
|           | 60 DAP             | 90 DAP             | 120 DAP        |  
| A         | 1.33 A             | 0.00 a             | 0.20 A         |  
| B         | 0.00 A             | 2.67 a             | 0.13 A         |  
| C         | 0.67 a             | 1.33 a             | 0.27 A         |  
| D         | 0.00 a             | 4.00 a             | 0.53 A         |  
| E         | 0.00 a             | 1.33 a             | 0.60 A         |  

Coefficient of Diversity (%) | 21.76 | 51.24 | 17.49

Notes: (A) Maruti variety, closed nursery, black silver plastic mulch (BSPM), plant distancing 75 cm x 60 cm, a dosage of solid organic fertilizer 20 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers; (B) Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 60 cm, a dosage of solid organic fertilizer 10 tons/ha and 135 N, P, K kg/ha of inorganic fertilizers; (C) Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 10 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers; (D) Maruti variety, closed nursery, BSPM, plant distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 20 tons/ha and 135 N, P, K kg/ha of inorganic fertilizers; and (E) Maruti variety, open nursery, plant distancing 75 cm x 30 cm and dosage of inorganic fertilizers 127 N, 60 P, 60 K kg/ha.

4. Conclusion and suggestion
The five technology packages applied was showed significantly different effects on the weight parameters of chili pepper per plant, however not show significant differences in growth parameters and chili pepper production. The treatment C used technology packages: Maruti variety, closed nursery, black silver plastic mulch (BSPM), plant distancing 75 cm x 40 cm, a dosage of solid organic fertilizer 10 tons/ha and 180 N, P, K kg/ha of inorganic fertilizers indicates higher chili pepper production reach 14.97 tons/ha. The caused injury of plants such as *M. persicae*, fruit flies, *Fusarium* wilt disease, and anthracnose was found at low levels of attack intensities. This technology package is expecting more development to support the increasing production of chili pepper in South Sulawesi.

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References
[1] Yanuarti AP dan Afsari MD 2016 *Profil komoditas barang kebutuhan pokok dan barang penting, komoditas cabai* (Jakarta:Kementerian Perdagangan Republik Indonesia)
[2] Puspitasari, Hardiyanto, Adiyoga W, and Kiloes AM 2019 Ex-ante study of chili multiple production technology in the rainy season: case study in Garut District, West Java *J. Hort.*, 29(2) 257-268
[3] Central Bureau of Statistic 2017 South Sulawesi in number Central Bureau of Statistic South Sulawesi
[4] Soetiarso TA and Setiawati W 2010 Technical and economical studies on two hot pepper varieties planting systems in highland areas. *J. Hort.* 20(3) 284-298
[5] Kirana R, Carsono N, Kusandriani Y and Lifredi 2014 Improvement of yield potency of pure line pepper with heterosis phenomenon at highland on dry season J. Hort. 24(1) 10–15
[6] Anwarudin MJS, Sayekti AL, Kiloes AM, and Hilman Y 2015 Production dynamic and price volatility of chili: anticipation strategy and development policy Pengembangan Inovasi Pertanian 8(1) 33-42
[7] Asniwati, Hidayat SH, Suastiga K, Sujiprihati S, Susanto S, and Hayati I 2012 Exploration of weak isolates of Chili Veinal Mottle Potyvirus from chili peppers in Jambi, West Sumatera and West Java. J. Hort. 22(2) 181-186
[8] Basuki RS, Arshanti IW, Zamzani L, Khaririyatun N, Kusandriani Y and Luthfy 2014 Adoption studies of red pepper Tanjung-2 varieties as a results of Vegetable Crops Research Institute in Ciamis, West Java Province J. Hort. 24(4): 355–362
[9] Ritonga AW, Syukur M, Sujiprihati S and Anggoro DP 2016 Growth and yield evaluation of nine hybrid pepper. J. Floratek. 11(2) 108–116
[10] Siahaan DS, Tarigan K, and Sebayang T 2016 Efisiensi penggunaan faktor produksi usahatani cabai merah agribisnis (Fakultas Pertanian, Universitas Sumatera Utara)
[11] Saptana, Daryanto A, Daryanto HK and Kuntjoro 2010 Production technical efficiency analysis of Great Red Chili farming and farmer’s behavior in dealing with the risks. Jurnal Agroekonomi 28(2): 153–188
[12] Soekartawi A, Dillon JL dan Hardaker JB 1986 Ilmu usahatani dan penelitian untuk pengembangan petani kecil Cetakan Ketiga (Penerbit Universitas Indonesia, Salemba Jakarta)
[13] Andayani SA 2016 The factors affect production of red chilli Mimbar Agribisnis 1(3) 261-268
[14] Soetiarsa TA, Ameriana M, Prabaningrum L, and Sumarni N 2006 Growth, yield and financial feasibility of the use of mulch and inorganic fertilizer on hot pepper off-season cultivation J. Hort. 16(1) 63-76
[15] Miskiyah dan Munarso SJ. 2009 Pesticide residue on red pepper, lettuce and shallots: case study on Bandungan and Brebes (Central Java) and Cianjur (West Java) J. Hort. 19(1) 101-111
[16] Sumarni N, and Muhamr A 2005 Budidaya Tanaman Cabai Merah Balai Penelitian Tanaman Sayuran, Pusat Penelitian dan Pengembangan Hortikultura (Badan Penelitian dan Pengembangan Pertanian, Jakarta)
[17] Syukur M, Sujiprihati S, Yunianti R, dan Kusumah DA 2010 Yield evaluation of pepper hybrids and their adaptation at four locations in two years J. Agron. Indonesia 38(1) 43-51
[18] Rahmi H, and Sirappa MP 2019 Technology innovation in red chili cultivation to support increased production in West Sulawesi Bulletin Inovasi Pertanian Spesifik Lokasi 5(1) 9-17
[19] Lologau BA, Ruchjaniningsih, Asriyanti, dan Salim 2018 Kajian teknologi budidaya cabai rawit off-season di lahan kering Laporan Hasil Penelitian Balai Pengkajian Teknologi Pertanian Sulawesi Selatan
[20]Nsabiyera V, Ochwo-Ssemakuka M, and Sseruwagi P 2012 Hot pepper reaction to field diseases African Crop Science Journal 20(1) 83-103
[21] Sumarni N, and Muhamr A 2003 Budidaya cabai merah Badan Penelitian dan Pengembangan Pertanian, Jakarta
[22] Nurahmi E, Mahmud T, and Rossiana SS 2011 Effectiveness of organic fertilizer on growth and yield of red chilli J. Floratek 6 158 – 164
[23] Boonlue S, Suwanarit P, Surapat W, Suwanarit A, Pukahuta C, and Morinaga T 2012 Diversity and efficiency of arbuscular mycorrhizal fungi in soils from organic chili (Capsicum frutescens) farms Mycoscience 53: 10–16
[24] Fahurrrozi, Stewart KA, and Jenni S 2001 The early growth of muskmelon in mulched mini-tunnel containing a thermal-water tube. I. the carbon dioxide concentration in the tunnel. J. Am. Soc. for Hort. Sci. 126 757-763
[25] Gunadi N and Sulastrini I 2013 The use of netting house and plastic mulch to increase the
growth and yield of hot pepper *J. Hort.* 23(1) 36-46

[26] Aditya A, Hendarto K, Pangaribuan D, dan Hidayat KF 2013 Pengaruh penggunaan mulsa plastik hitam perak dan jerami padi terhadap pertumbuhan dan produksi tanaman cabai merah (*Capsicum annum* L.) di dataran tinggi *J. Agrotek Tropika* 1(2) 147-152

[27] Setiawati W, Hasyim A, Udiarto BK and Hudayya A 2020 Effect of magnesium, boron and biofertilizers on chili pepper productivity and impact of pests and disease. *J. Hort.*, 30(1) 65-74