

ABSTRACT

Puji Harsono. The study of physiological relationship between gibberellic acid (GA₃) and mulches with the growth and yield of chilli (*Capsicum annuum*, L.) during different seasons.

The aims of this research were (i) to find out the effect of the various types of mulches and different seasons on the microclimate and the character of the soil chemistry, (ii) to find out the effect of mulching on the growth and yield of chilli during different seasons, (iii) to find out the effect of gibberellic acid (GA₃) on the growth and yield of chilli during different seasons, and (iv) to find out the relationship between GA₃ and using different mulches with the growth and yield of chilli in different seasons.

This field research was conducted in the Joho Village, at Sukoharjo sub district, in the region of Sukoharjo, at a level of 120 m above sea level and a Vertisol type soil. The research was carried out during the dry season from May until October 2003 and during the rainy season from January until June 2004. A split plot design using three replications was used to study the relationship between GA₃ and using different mulches on the growth and yield of chilli in different seasons. The main plot consisted of different types of mulches, they were soil without mulch as control (M0), plastic polyethylene (M1), the rice straw (M2), rice husk (M3) and corn waste (M4). Organic mulch were added 6 tons per hectare. The sub plot consisted of different concentration of GA₃: 5 ppm GA₃ (G1), 10 ppm GA₃ (G2), 15 ppm GA₃ (G3), 20 ppm GA₃ (G4), and without GA₃ (G0) as control.

The results showed that during the dry season of 2003, the application of 6 tons per hectare of organic mulches increased the soil temperature, soil water content, cation exchange capacity (CEC), pH, the level of organic C in the soil, total N, the level of potassium (K), and decreased the ratio of C/N in the soil but did not affect the level of available P. While the result from rainy season of 2004 showed a significant increase in soil temperature, organic C in the soil, soil organic matter, available P, total N, C/N ratio, and the level of ambient CO₂. However, the pH and the level of K were not affected by the application of organic mulches.

The application of organic mulches during the dry season of 2003 compared to the use of polyethylene plastic, did not show any significant difference on the level of available P but caused an increase in CEC, pH, soil organic C, soil organic material, total N, available K, soil C/N ratio, soil water content and decreased the soil temperature. During the rainy season in 2004, the effects of the organic mulches and the polyethylene plastic did not differ significantly. However there was an increase in the soil organic C, soil organic material, available P, total N, soil C/N ratio and ambient CO₂, but caused a decreased in soil temperature.

In the dry season of 2003, the chilli crops that were planted using organic or non organic mulches, caused a higher result in the absorption of N, fruit length, fruit production, and growth components (internode length, branch number, leaf area, leaf area index, dry leaf weight), compared to those planted without mulches. The average yield of chilli per plant that was using a mulch increased as much as 350 g during the dry season 2003 and 420 g in the rainy season 2004 compared to those that were not planted with mulches (M0). The rice straw mulch gave the highest average fruit production of 1.29 kg per plant (dry season 2003) and 1.15 kg per plant (rainy season 2004). Fruit yield per plant using organic mulch during the dry season 2003 and rainy season 2004 were higher compared to the plants using plastic mulch (M2). The increase in yield were 100 g per plant in the dry season 2003 and 126 g per plant during the rainy season.

The application of GA₃ on the leaves at 35-110 days after planting with an interval of 2 weeks compared to the control (G0) during the dry season 2003 and rainy season 2004, significantly increased the absorption of N, fruit length, fruit yield, and growth components. In the dry season 2003, the maximum fruit yield per plant (1.29 kg) was reached using 15 ppm GA₃. The optimum level of GA₃ used for spraying was 11.67 ppm in the rainy season 2004 which produced 1.13 kg fruit per plant.

There was a significant interaction between the mulch treatment and the application of GA₃ on the plant height, plant dry weight, and GA₃ concentration in the leaf tissues. The highest plant was obtained with the organic mulch using rice residues (M2 and M3) with 15 ppm GA₃ (G3). The plant reached 107.67 cm (M2G3) during the dry season 2003 and 132.33 cm (M3G3) during the rainy season 2004. The best growth and development of the root system were found on chilli plants that were planted on rice straw mulches and given 10 ppm GA₃ during the dry season 2003 and 15 ppm GA₃ during the rainy season 2004, and the root weights were 9.6 g (M2G2) and 8.44 g (M2G3). The highest production of biomass was found on chilli plants given a combination treatments of rice straw mulch and 15 ppm GA₃ (M2G3). The average dry weight of the plants during the dry season 2003 was 302.53 g and during the rainy season 2004 was 124.24 g. The application of 15 ppm GA₃ that was sprayed on the leaves of the chilli plants planted with rice straw mulch (M2G3) during the dry season 2003 and using the corn residue (M4G3) during the rainy season 2004 caused the highest level of GA₃ in the leaves, as much as 1883.22 µg.g⁻¹ and 1251.63 µg.g⁻¹.

The results showed that there was a significant interaction between the mulch treatment and the use of GA₃ on the physiological parameters: the net assimilation rate (NAR) and the crop growth rate (CGR) at 87-127 days after planting. The chilli plants that were given rice straw mulch and 15 ppm GA₃ (M2G3) in the dry season 2003 and in the rainy season 2004 gave the highest average of NAR and CGR. The NAR were 565 mg.dm⁻².day⁻¹ (dry season 2003) and 162 mg.dm⁻².day⁻¹ (rainy season 2004). The CGR were 982 mg.dm⁻².day⁻¹ (dry season 2003) and 86 mg.dm⁻².day⁻¹ (rainy season 2004).