

## **LENGTH OF VEGETATION PERIOD AND FRUIT SET IN PEPPER GROWN ON DIFFERENT TYPES OF MULCH**

**Zvezda Bogevska<sup>1\*</sup>, Gordana Popsimonova<sup>1</sup>, Rukie Agic<sup>1</sup>, Margarita Davitkovska<sup>1</sup>, Daniela Trajkoska<sup>2</sup>, Maja Sudimac<sup>3</sup>**

<sup>1</sup>University of Ss. Cyril and Methodius, Faculty of Agricultural Sciences and Food, Skopje, Republic of North Macedonia

<sup>2</sup>Agrofarm, Demir Hisar, Republic of North Macedonia

<sup>3</sup>Tamis Research and Development Institute, Republic of Serbia

\*e-mail: zvezda@fznh.ukim.edu.mk

### **ABSTRACT**

Mulching is a common practice of covering the soil to make favorable conditions for plant growth, development, and efficient crop production. The study aimed to determine the influence of different mulching materials on some parameters of pepper Kapija type grown in an open field. The experiment was set in the village of Kutretino near Demir Hisar, during the season of 2018. The treatments were as follows: no mulch (bare soil) - as a control treatment, straw mulch, black film mulch, white on black (double face) film mulch, and red film mulch. A single experimental plot was 15 m<sup>2</sup> with a density of 100 plants per plot organized in a complete randomized block design in four replications. During the vegetation, there was monitoring of some phenological stages. In addition, on ten plants per replication, the number of flowers and the number of fertilized flowers were recorded. The earlier botanical maturity was in straw mulch and black foil mulch or 153 days after germination. The latest was in red foil mulch or 161 days after germination. The largest number of flowers had the plants from the black foil mulch an average of 11.83 flowers, out of which 10.95 were fertilized, which means that 92.56% of the flowers set fruit. Plants on red mulch had the least number of flowers, 7.33 on average, of which 5.73 were fertilized, leading to 78.17% of fruit set. White on black mulch had the highest percentage of fruit set (93.7%) because of favoring condition.

**Key words:** foils, straw, earliness, number of flowers, number of fertilized flowers

### **INTRODUCTION**

While organic mulches such as wheat straw, dead leaves, and compost have been used for centuries during the past 60 years, the beginning of artificial materials has modified the methods and advantages of mulching (Ahmad et al., 2011). Plastics are the most widespread mulching materials, especially black polyethylene which is used almost everywhere due to its low price and proven positive results in production although the use of biodegradable films is now increasing (Ray & Biswasi, 2016). Mulching has become an important practice in modern field production due to benefits such as an increase in soil temperature, reduced weed pressure, moisture conservation and efficient use of water, reduction of certain pests, higher crop yields, more efficient use of soil nutrients, and better microbial activity in the soil through the improvement of soil agrophysical properties (Iqbal et al., 2009; Marichamy et al., 2016; Ray & Biswasi, 2016). The mulch materials influence the number of flowers also reduce the number of days to flower as well as have a positive effect on the fruit set (Kumar & Verma, 2009; Iqbal et al., 2009; Ahmad et

al., 2011; Marichamy et al., 2016; Verma et al., 2016; Tomar et al., 2018; Molla et al., 2019; Debbarma et al., 2019). Many studies also reported an increment in the early and total yield of vegetables grown on different mulching materials (Ibarra-Jimenez et al., 2004; Kumar and Verma, 2009; Molla et al., 2019; Debbarma et al., 2019; Karki et al., 2020; Bogevska et al., 2021; Adamović et al., 2021). Yield can be improved by using mulches in vegetables from 17.39% in chili peppers to 60.74% in broccoli (Ray & Biswasi, 2016). Even mulching is an important aspect of seed production technology for crops that possess the capability of increasing the quality and quantity of seed yield (Verma et al., 2016; Molla et al., 2019).

The length of the pepper vegetation is the life cycle of the plant from germination to maturity (Gvozdenović, 2010). But in production, depending on the type of purpose the pepper is grown for, the term 'earliness' is used to describe the number of days from sprouting to the technological or botanical maturity (Bogevska et al., 2017). For crop improvement purposes selection for the traits, days to flowering, and days to fruiting will contribute to pepper earliness, thus it will increase the economic value of Kapija type genotypes (Trajkova & Koleva Gudeva, 2017). At an earlier time, Lamont, 1993 resumed that the use of plastic mulches shorten the vegetation period (7 to 14 days) and increased yields (two to three times) over bare soil in many vegetable crops. Thus, the aim of this study was to determine the influence of different mulching materials on stages of growth, earliness, and some reproductive traits of the pepper Kapija type.

## **MATERIAL AND METHODS**

The research was carried out in 2018 on a pepper Kapija type originating from Turkey (Bursa Tohum Seed Production Company) in the vicinity of the village Kutretino, near Demir Hisar (41.22°N, 21.20°E, altitude 700 m).

The experiment included four treatments compared to the control – no mulch: treatment 1 – wheat straw mulch (thickness of layer 5 cm); treatment 2 – black film mulch (20 µm thickness); treatment 3 – white on black film mulch (20 µm thickness); and treatment 4 – red film mulch (20 µm thickness). The distance between the rows was 60cm and 25cm between the plants. Each experimental plot had 100 plants on a surface of 15 m<sup>2</sup>. The plots were organized into a complete randomized block system with 4 replications, or 20 experimental plots in total (300 m<sup>2</sup>). The plants were grown from seedlings. Seedlings were sown on 15.3.2018, sprouted on 1.4.2018, and transplanted on 30.5.2018. During the vegetation, custom agricultural practices were applied such as drip irrigation, top dressing, and plant, protection.

During the vegetation period, the date of 50% flowering, the date of technological fruit maturity, and the date of botanical fruit maturity was observed. The number of days from sprouting to 50% flowering and the number of days from sprouting to botanical maturity (length of vegetation period in pepper Kapija type) were calculated.

The number of flowers and the number of fertilized flowers was counted on ten plants per replication.

The % of the fruit set was calculated by the formula given by Ahmad et al, 2011 and Marichamy et al., 2016. Obtained data were statistically processed by analysis of variance (ANOVA). The critical difference was worked out for 1 and 5 percent levels of significance.

## **RESULTS AND DISCUSSION**

The length of individual stages of growth and development of the pepper depends on the cultivar and can be: from sowing to germination 8-12 days, from germination to flowering 70-80 days, from flowering to the beginning of harvest 40-50 days and from technological to

physiological maturity 20-30 days (Maksimović, 2007). Years ago, Gjeorgievski et al., 1997 examined several lines of Kurtovska Kapija in the Strumica region and found out that the number of days of planting and sprouting was 21 days for all, sprouting to flowering (89-93 days), sprouting to technological ripeness (142-145 days), and sprouting to physiological ripeness (157-161). Trajkova and Koleva Gudeva, 2017 found out that KK1 and KK2 genotypes had 46.3 and 46.5 days to flowering, respectively, while the control KKk had 76 days. In addition, the length to physiological fruit maturity was 121 days for both genotypes and compared to the length of phenophase to physiological maturity for control, genotypes KK1 and KK2 were 5.7 days earlier than the control Kurtovska Kapija. The mulching influenced the number of days from sprouting to 50% flowering and the number of days from sprouting to botanical maturity (Table 1). The fewest number of days from sprouting to botanical maturity was observed in the black and straw mulch (153 days), while the vegetation was delayed by a few days in red mulch. Debbarma et al., 2019 got that the minimum number of days to 50 % flowering was noticed in treatment by receiving 40 % irrigation and using black plastic mulch in bell pepper grown in protected houses. Molla et al., 2019 found that the earliest dates to 50% flowering, 50% pod setting, and maturity in hot pepper were attained with transparent plastic mulch followed by dry banana leaves mulch. Marichamy et al., 2016 indicated that the plants grown over black-on-white mulch took minimum days to flower, whereas, chili grown over leaf litter mulch and unmulched control took maximum days to flower and in comparison to the organic mulch materials and unmulched control, the plastic mulches significantly advanced the flowering in chili plants. In addition, Ahmad et al., 2011 and Iqbal et al., 2009 confirmed that transparent (clear) plastic mulch and black polyethylene mulch were found to be effective in chili production. Despite these results, in tomatoes the application of bio-mulch produces significant maximum days to 50 % flowering, the number of flowers per inflorescence, and inflorescence per plant as well as days taken to the first and the last harvest.

**Table 1. Some phenological stages after transplanting and length of vegetation period**

Treatments	Date of 50% flowering	Date of technological fruit maturity	Date of botanical fruit maturity	Number of days from sprouting to 50% flowering	Number of days from sprouting to botanical maturity
No mulch	17.06.18	10.08.18	04.09.18	78	156
Straw	14.06.18	07.08.18	01.09.18	75	153
Black foil	14.06.18	07.08.18	01.09.18	75	153
White on black foil	15.06.18	09.08.18	03.09.18	76	155
Red foil	17.06.18	15.08.18	09.09.18	78	161

The pepper Kapija type grown on different mulches formed a relatively different number of flowers and a different number of fertilized ones (Figure 1). The advantage of outdoor cultivation is the normal flow of pollination, i.e. impossibility of pollination problems, which is not the case when it comes to protected production, primarily due to high temperatures. The highest number of flowers had the plants from the mulch with black foil an average of 11.8 flowers, of which 10.95 were fertilized. The plants from the red mulch had the fewest flowers, 7.3 on average, and 5.7 of them were fertilized. The number of flowers in the control was on average 8.3, of which 7.6 were fertilized, while in straw the number of flowers per plant was 8.0, of which 7.25 were fertilized. A significant difference at a level of 0.01 was determined between the number of flowers and fertilized flowers on black foil compared to all tested mulching.

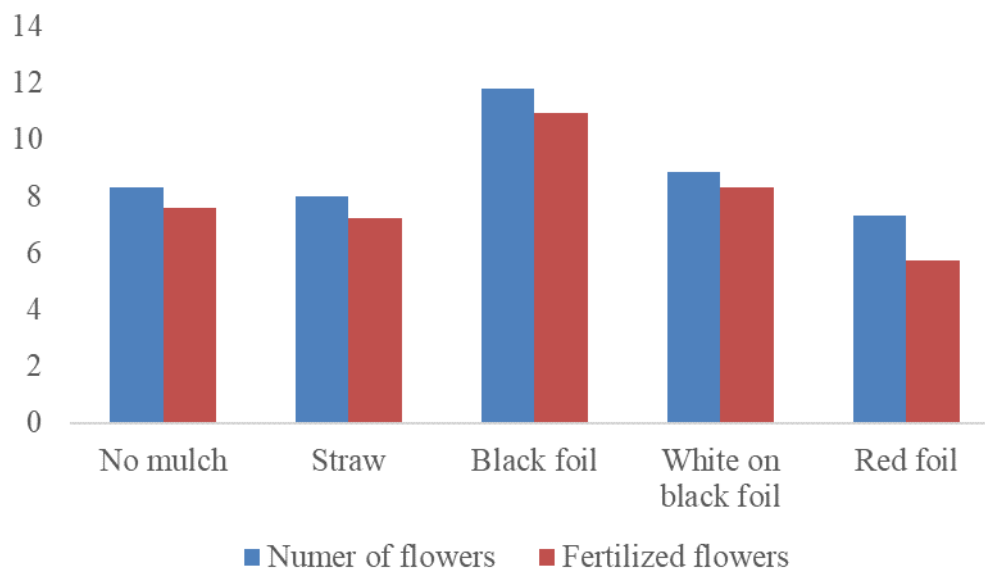


Figure 1. Number of flowers and number of fertilized flowers

Arancon et al., 2004 found that the number of flowers of peppers grown in potting mixtures containing 10–80% vermicompost although greater did not differ significantly from those of peppers grown in MM360, whereas the pepper plants grown in the 80% vermicompost/20% MM360 had most flowers (8.6). In the Kapija pepper type, the average number of 7.56 flowers per plant for KK1 genotype was significantly lower than the flower number of KK2 (16.47 flowers) and control Kurtovska Kapija (14.43 flowers) however the mean number of fertilized flowers was 3.79 (KK2), 5.60 (KK1) and 5.21 (control Kurtovska Kapija) (Trajkova & Koleva Gudeva, 2017). In other research concerning bell pepper production in protected houses in India, the highest number of flowers (31.73) was obtained on black foil among other factors (Kumar & Verma, 2009). Tomar et al., 2018 found that tomato grown with bio-mulch produces the maximum number of flowers/inflorescence and number of inflorescence per plant. While in cucumber the highest number of male (69.50) and female (33.50) flowers per plant were recorded in silver on black polyethylene mulch used (Karki et al., 2020).

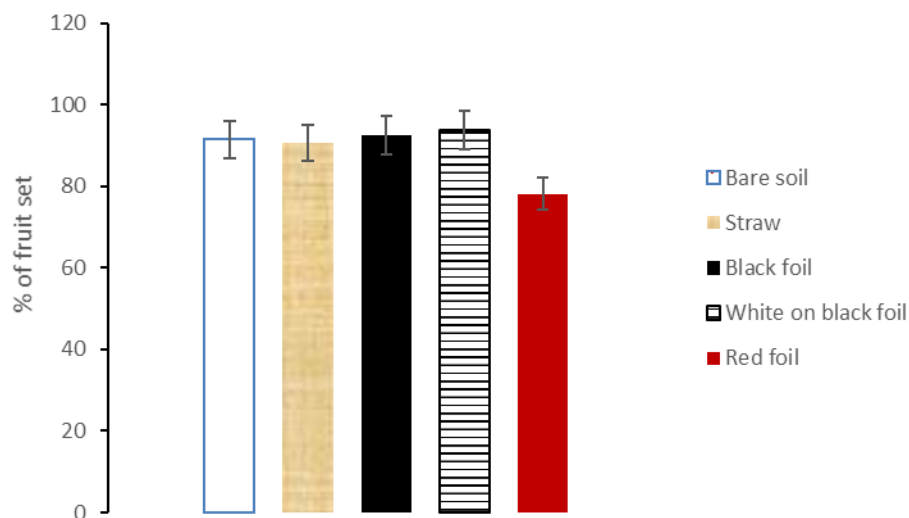


Figure 2. Percentage of fruit set in pepper grown on different mulches

Mulching influenced the percentage of fruit set in pepper Kapija type grown in the open field (Figure 3). The percentage of fruit set was very high over 90% except in pepper grown on red foil (78.17%). Following this percentage of fruit set, Bogevska et al., 2021 found that the number of fruit was highest in the black mulch treatment (8.45) and the least in the red mulch treatment (5.58). Although cultivation in protected areas can disrupt pollination due to high temperatures, Bogevska et al., 2017 found that the number of fruit set as a percentage of pollination was from 68, 57% in kaloca to 82.50% in KP 4. The ability of organic mulches to conserve soil moisture, accompanied by lowering soil temperatures, might have improved the fruit sets and eventually increased fruit number (Fahrurrozi & Ganefianti, 2019). Ahmad et al., 2011 found that the maximum fruit set (86.66%) has been observed in chili pepper grown when transparent plastic mulch was used. This might be due to the better vegetative growth of chili plants under mulch material which results in more flowers and branches per plant; as a result, the fruit set increased. Also, Marichamy et al., 2016 confirmed that the maximum fruit set was observed in black-on-white mulch followed by black-on-silver mulch while Kumar and Verma, 2009 found that more fruit set (60.04%) was observed in bell pepper production in low-cost naturally-ventilated plastic houses grown on black foil.

## CONCLUSIONS

Having in mind the advantages of using mulch materials which were confirmed in this research in accordance with previously published results, it can be concluded that pepper Kapija type can be successfully grown on black foil and white on black foil in the open field in order to improve earliness, induce more flowers production, and achieve better fruit set.

## REFERENCES

- Adamović, B., Paroški, D., Vojnović Đ., & Ilin, Ž. (2021). The effect of mulching and low tunnel on the yield, yield components, and quality of watermelon. *Acta Hort.* 1320, 101-108. DOI: 10.17660/ActaHortic.2021.1320.13
- Ahmad, I., Hussain, Z., Raza, Memon, N.U.N., & Naqvi, S. A. (2011). Response of vegetative and reproductive components of chili to inorganic and organic mulches, *Pak. J. Agri. Sci.*, Vol. 48(1), 19-24.
- Arancon, N. Q., Edwards, C. A., Atiyeh, R., & Metzger, J. D. (2004). Effects of vermicomposts produced from food waste on the growth and yields of greenhouse peppers. *Bioresource Technology* 93: 139–144.
- Bogevska, Z., Popsimonova, G., Agic, R., & Davitkovska, M. (2021). Influence of mulching materials on pepper (*Capsicum annuum* L. ssp. *macrocarpum* var. *longum*) characteristics. *Acta Hort.* 1320, 87-92. DOI: 10.17660/ActaHortic.2021.1320.11
- Bogevska, Z., Popsimonova, G., Agic, R., & Davitkovska, M., (2017). Comparative Trials on Kapija Type Pepper Cultivars. *Journal of Agricultural, Food and Environmental Sciences*, vol. 71, no. 2, Skopje, 15-22.
- Debbarma, S., Bhatt, L., & Uniyal, S. P. (2019). Response of Bell Pepper (*Capsicum annum* L. var. *grossum*) to Drip Irrigation Levels and Black Plastic Mulch under Naturally Ventilated Polyhouse. *Int. J. Curr. Microbiol. App. Sci.* 8(10): 449-458 <https://doi.org/10.20546/ijcmas.2019.810.048>

- Fahrurrozi, F., & Ganefianti, D.W., (2019). Early yield responses of three promising chili pepper hybrids to different mulch types. *Asian J. Agric. Biol.* 7(4):548-554.
- Gjeorgievski, S. M., Kocevski Gj. V., Jakimov N. D., & Koleva R. Lj., (1997). The production and technological characteristics of some lines of pepper variety kurtovska kapija in the region of Strumica. Proc. First Balkan Symp. Vegetables and Potatoes. *Acta Hort.* 462: 717-720.
- Gvozdrenović, Đ. (2010). *Paprika*. Institut za ratarstvo i povrtarstvo, Novi Sad:32, 247.
- Ibarra-Jimenez, L., Quezada-Martin, M.R., & Dela Rosa-Ibarra, M., (2004). The effect of plastic mulch and row covers on the growth and physiology of cucumber. *Aust. J. Exp. Agric.* 44: 91-94.
- Iqbal, Q., Amjad, M., Rafique Asi, M., Asif Ali, M., & Ahmad, R. (2009). Vegetative and reproductive evaluation of hot peppers under different plastic mulches in poly/plastic tunnel. *Pak. J. Agri. Sci.*, 46(2): 113-118.
- Karki, A., Sapkota, B., Bist, P., Bista, K., Dutta, J.P., Marahatta, S., & Shrestha, B., (2020). Mulching materials affects growth and yield characters of cucumber (*Cucumis sativus* cv. Malini) under drip irrigation condition in Chitwan, Nepal. *Journal of Agriculture and Forestry University*, Vol. 4: 153-159.
- Kumar, M. & Verma, V. (2009). Bell Pepper (*Capsicum annuum* L.) Production in Low-Cost Naturally-Ventilated Polyhouses during Winters in the Mid Hills of India. Proc. IS on Prot. Cult. Mild Winter Climate. *Acta Hort.* 807: 389-394.
- Lamont, W.J. (1993). Plastic mulches for the production of vegetable crops. *Hort. Technology* 3(1): 35-39.
- Maksimović, P. S., (2007). *Proizvodnja povrća u zaštićenom prostoru*. Patenon, Beograd: 127.
- Marichamy, M.S., Thomas, Anju, Thomas, Anisha, Jayabharathi, J., & Kanthaswamy, V. (2016). Effect of Different Mulches on Vegetative and Reproductive Components of Chilli (*Capsicum annuum* L.) Hybrid Sierra. *Advances in Life Sciences* 5(3), 888-893.
- Molla, T., Abera, G., & Beyene, S. (2019). Effects of Nitrogen Fertilizer and Mulch Application on Growth Performance and Pod Yields of Hot Pepper (*Capsicum annuum* L.) under Irrigated Condition. *International Journal of Plant & Soil Science* 27(5): 1-15. DOI: 10.9734/IJPSS/2019/v27i530089
- Ray, M., & Biswasi, S., (2016). Impact of Mulching on Crop Production: A Review. *Trends in Biosciences* 9(14): 757-767.
- Tomar, S., Dubey, A. K., Chaudhary, M., Singh, J. P., & Jeevan, R., (2018). Effect of Different Dates of Transplanting and Mulching on Flowering and Fruiting Behaviour of Tomato (*Lycopersicon esculentum* Mill.), *Int. J. Pure App. Biosci.* SPI: 6(3): 676-680.
- Trajkova, F. & Koleva Gudeva, L. (2017). Assessment of Reproductive Traits of Different Androgenic Pepper Lines (*Capsicum annuum* L.). *Annual Research & Review in Biology* 19(2): 1-13 DOI: 10.9734/ARRB/2017/37324
- Verma, R., Mehta, D. K., Thakur, K. S., Prasad, H., & Lal, M. (2016). Effect of Mulching and Planting Geometry on Seed Production of Bell Pepper (*Capsicum annuum* L.) in Mid-hills of Himachal Pradesh. *International Journal of Bio-resource and Stress Management*, 7(5):1146-1151 <https://DOI.ORG/10.23910/IJBSM/2016.7.5.1617>