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Weed Management in Maize: Mulching is a Next Alternative to Herbicide

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Abstract

Maize is the staple food crop of hills and a major component of livestock and poultry feed in Nepal. Controlling weeds is one of the most crucial elements that significantly impact maize production and profitability. Manual weeding is common but costly, whereas herbicidal weeding is effective but hazardous to the environment. In winter maize, broadleaf weeds are more dominant than grasses and sedges. (IVI), the highest IVI (Importance Value Index) was recorded in *Poa annua* L. (25%), and *Ranunculus arvensis* L. (24.2%) respectively. Weed infestation leads to yield losses ranging from 18% to as high as 85 % depending on season and the intensity of weed infestation in crop fields. Depending upon the maize planting season, a critical period for weed control is 2 to 8 weeks in winter and 2 to 9 weeks in summer. Both live and plastic mulch reduces weed density and dry matter efficiently, blocks light to inhibit weed growth and also helps to conserve moisture and soil temperature. Weed control efficiency of black plastic mulch is highest at 96.2%, 90.10%, 85.62%, and 74.30% at 30 DAS, 60 DAS, 90 DAS, and at harvest respectively. In both Plastic and live mulch, yield attributes; such as ear harvested per hectare, number of grains per ear, and 1000 grains weight per cob are significantly affected which ultimately affects the yield. Overall, both live and plastic mulching techniques present sustainable alternatives to weed management contributing to the long-term viability of maize cultivation in Nepal.

Keywords: Importance value index, mulch, yield

Introduction

Maize (*Zea mays* L.) also known as "Queen of Cereals" is the most important cereal crop grown in the world. In Nepal, maize is the second most important cereal crop after rice. The yield of maize in Nepal is 3.17 t/ha (MoALD, 2024. In a hilly region, it is the principal food crop whereas, in the Terai region, it is the important source of raw materials for different animal feed industries (KC et al., 2015). Gurung et al. (2011) reported that more than 86% of the maize produced in hills is used for human consumption, and in Terai, more than 80% of maize produced is used for poultry and animal feed. Food grain consumption will undoubtedly rise in the future due to Nepal's population growth, which is expected to expand at a pace of 1.28% per year over the next 10 years (CBS, 2014). However, there are several reasons why maize crop production is so low. The main issues with maize production have been disease, weed infestation, pests, and a decrease in organic matter present.

Weed is an unwanted plant that decreases crop yield and quality and acts as an alternate host. (Pandya et al., 2000). One to eight weeks following crop emergence is an important time for weed control in maize (Ghosheh et al., 1996). In the Nepalese highlands, Karki et al. (2010) found that weed infestation reduced maize grain production by 48%; the extent of the yield loss varied according to the kinds and intensity of the weed flora. Lagoke et al. (1998) reported that yield losses in maize of 60-81% occur due to weed infestation. Timsina et al. (2019) reported that weed infestation affects phenological observation, grain yield, and yield attributes in maize. Varieties of weed management techniques, including cultural, physical, biological, and chemical methods, are employed. Physical techniques are still helpful tools, but they are costly, time-consuming, and labor-intensive. Increasing labor costs and more labor requirements for weed control are making maize cultivation uneconomical (Nadeem et al., 2010). Chemical weed management is a quicker, more efficient, labor- and time-saving strategy than others. The usage of herbicides becomes crucial in these circumstances. It is also known that persistent application of a single herbicide can cause a change in the flora of weeds and the evolution of herbicide resistance in weed species (Thakur & Sharma, 1996).

Due to their advantages in preserving soil moisture, controlling soil temperature, controlling weed growth, and enhancing crop productivity, cultural techniques like polythene mulch and biological mulch like *lantana camera* have also seen a sharp rise in use in agriculture (Timsina et al., 2019). Despite the availability of these various weed management techniques, the selection and implementation of effective, economically viable, and environmentally sustainable methods remain critical for optimizing maize productivity and addressing the rising demand for food grains in Nepal.

Methodology

An extensive review was done to collect accurate data from different annual reports, booklets, thesis works, national journals, and so on from different national, public, and private organizations. Similarly, some findings are based on information from a thesis done in the respective field from the Department of Agronomy, Agriculture and Forestry University, Rampur, Chitwan.

Results and Discussion

Weed Flora in Maize and Yield Loss

Types of Weed Flora at Different Growth Stages

Weed dynamics throughout the winter maize cropping system in Nepal (Timsina, 2018) are shown in Table 1. The table depicts which species persist over time and at what stage they become problematic. Grasses like *Digitaria ciliaris* and *Cynodon dactylon* are persistent throughout the entire period, while sedges like *Cyperus rotundus* are also consistently present. Broadleaf weeds display more variation, with some like *Ageratum conyzoides* appearing throughout, while others like *Oxalis corniculata* are present only early in the cycle. Understanding the growth patterns of these weeds helps inform effective management strategies for different growth stages.

Table 1

Description of weeds recorded at different growth stages of winter maize at NMRP, Chitwan, Nepal

Scientific name	Local name	Common name	Family	30 DAS	60 DAS	90 DAS	At Harvest
Grasses							
Digitaria ciliaris (Retz.) Koel	Chittrey Banso	Crab grass	Poaceaea	+	+	+	+
Cynodon dactylon (L.) Pers.	Dubo	Bermunda grass	Poaceaea	+	+	+	+
Eluesine indica (L.)Gaertn	Kode jhar	Goose grass	Poaceaea		+	+	
Ehinochloa colonum(L.)	Sama	Jungle rice	Gramminae			+	+
Sedges							
Firmbristylis miliacea	Jwane jhar	Grass like firmbry	Cyperaceae	+	+	+	+
Cyprus rotundus (L.)	Mothe	Purple nutsedge	Cyperaceae	+	+	+	+

Broadleaf							
Ageratum conyzoides L.	Gandhe jhar	Goat weed	Compositae	+	+	+	+
Oxalis corniculata(L.)	Chari amilo	Yellow sorrels	Oxalidaceae	+	+		
Solanum nigrum(L.)	Kali gedi	Black night shade	Solanaceae	+	+		
Cleome vicosa(L.)	Ban tori	Asian spider flower	Cleomaceae	+			
Polygonum plebeium(R.Br.)		Knot weed	Polygonaceae	+	+	+	
Tridex percumbens(L.)	Putali jhar	Coat buttons	Asteraceae	+	+		
Leucas cephalotus(Roth). Spreng			Compositate	+	+		
Borreria levis(Lam.)	Marote	Button weed	Rubiaceae	+			+
Chenopodium album (L.)	Bethe		Chenopodia-ceae	+		+	
*Commelina bengalensis (*Linn.)	Kane jhar	Day flower	Commelin-aceae	+	+	+	
Vicia sativa (L.)	Kutilko-sa	Common vetch	Leguminosae			+	+
Ceratothea sesa-moides(Endl.)	Bantil	False sesamum	Pedeliaceae			+	
Fumaria parviflora(Lam.)	Ghajar jhar		Papavariaceae			+	
Anagalis arvensis (L.)	Nil jhar	Scarlet pimpernel	Primulaceae				+
Gnaphalium purpureum (L.)	Boke jhar	Cud weed	Asteraceaae				+

Amaranthus spinosus (L.)	Lunde kada	Spiny amaranthus	Amaranthaceae		+
Euphorbia hirta (L.)	Dude jhar	Asthma weed	Euphorbiaceae		+

Dominant Weed Flora in Winter Maize

The common and significant weeds with the relative abundance and ecological importance of different weed species in winter maize in India are given in Table 2. The Importance Value Index percentages give insight into which species are likely to be most competitive in agricultural or natural settings, with species like *Poa annua (25.0%)*, *Ranunculus arvensis (24.20%)*, and *Stellaria media* (23.70%) showing high ecological dominance.

Table 2

List of dominant weed flora in winter Maize

Weed	Family	IVI (%)	References
Portulaca oleracea L.	Dicot	3.52	Barad et al. (2016)
Euphorbia hirta L.	Dicot	7.77	Barad et al. (2016)
Vicia sativa L.	Dicot	17.50	Mujahed, (2021)
Digera arvensis Forsk	Dicot	19.21	Barad et al. (2016)
Vicia hirsuta (L.) Gray	Dicot	19.60	Mujahed, (2021)
Chenopodium album L.	Dicot	19.70	Barad et al. (2016)
Anagallis arvensis L.	Dicot	21.40	Mujahed, (2021)
Fumaria parviflora L.	Dicot	21.70	Mujahed, (2021)
Stellaria media (L.) Vill.	Dicot	23.70	Mujahed, (2021)
Ranunculus arvensis L.	Dicot	24.20	Mujahed, (2021)
Asphodelus tenuifolious L.Cav.	Monocot	1.79	Barad et al. (2016)
Lolium temulentum L.	Monocot	20.60	Mujahed, (2021)
Phalaris minor Retz.	Monocot	21.40	Mujahed, (2021)
Poa annua L.	Monocot	25.0	Mujahed, (2021)
Cyperus rotundus L.	Sedges	21.29	Barad et al. (2016)
Brachiaria spp.	Grasses	17.67	Barad et al. (2016)

Note. IVI- Importance value index

Yield Losses Due to Weeds

Table 3 shows crop yield losses during the Kharif and Summer seasons based on multiple studies, with losses ranging from 28% to 100% for Kharif and up to 65% for Summer. The wide range indicates that in some cases, losses can be moderate, while in other cases, crop losses can be total (100%). This may be due to regional variability, the nature of the crop, other agronomic factors, and harsher environmental conditions, including extreme heat and water scarcity, that typically affect crop productivity.

Table 3

Yield loss of maize in different cropping seasons

Seasons	Yield loss	References
Kharif	37.35 %	Sharma et al. (2000)
Kharif	28-100%	Pandey et al. (2002)
Kharif	33-50%	Shantveerayya & Agasimani (2012)
Summer	65%	Ehsas et al. (2016)
Summer and Kharif	18-85%	Jagadish et al. (2016)

Critical Period for Crop Weed Competition on Maize (CPWC)

Table 4 shows the critical period for weed control (CPWC) during different growing seasons. For both summer and winter, the CPWC is at the 3-10 leaf stage of the crop. In the rainy season, it ranges from 20-30 days or 3 to 6 weeks, depending on the study. During winter, CPWC is 2 to 8 weeks, while in summer, it spans 2 to 9 weeks or 10 to 47 days afters sowing (DAS), according to different studies. These periods represent the optimal periods for effective weed management to minimize yield losses.

Table 4

Critical period for crop weed competition on maize for different seasons

Growing season	CPWC	References
Both summer and winter	3-10 leaf stage	Dogan et al. (2004)
Rainy	20-30 days	Mathukia et al. (2014)
Winter	2 to 8 weeks	Mahgoub et al. (2013)
Summer	2 to 9 weeks	Mahgoub et al. (2013)
Rainy	3 to 6 weeks	Imoloame & Omolaiye (2016)
Summer	10 to 47 DAS	Rana &Rana (2016)

Mulching is the Next Alternative to Herbicide

Herbicides serve a purpose in raising agricultural productivity and profitability. Herbicides frequently offer good and affordable weed management; nevertheless, relying solely on chemicals to control weeds can be detrimental (Vencill et al., 2012). Herbicide-resistant weed populations exist worldwide as a result of an overreliance on the use of a single herbicide and a failure to employ non-chemical weed control strategies (Duke & Powels, 2008; Hager, 2011; Heap, 2015).

Therefore, various weed management techniques that are less time-consuming, more efficient, cost-effective, and environmentally appropriate for the area could be used to solve this issue, such as mulching. Mulch is a layer of particles placed on the soil's surface to provide protection. Mulching hinders top development and inhibits weed growth by blocking light from reaching a plant's photosynthetic components. When it comes to annual weeds and certain perennial weeds like *Cynodon dactylon*, it works really well. Plastic sheets, polythene film, or dry or green crop wastes are used for mulching.

Mulch is a versatile material that is applied to weed control. Organic mulches include stubbles, agricultural wastes, legume straws, and cereal straws. Synthetic mulches include paper, plastic, and materials constructed of artificial fibers (Shoemaker, 1978). Mulching is a very successful method of controlling weeds because it reduces weed seedlings, especially during the crop establishment stage. Either when combined with other weed management techniques, residue-mulching stops weed development due to its allelopathic action or blocks the light needed for weed seed germination (Teasdale & Mohler, 2000).

The live cover crop velvet beans cut weed biomass by 68% (Caamal-Maldonado et al., 2001). Crop residue mulching helps to control the weed germination. Elicin et al. (2018) reported that six tons per ha live mulching helps to reduce the weed population.

Live Mulch for Weeds Management in Maize Cultivation

Live mulch involves the use of living cover crops or plants grown alongside maize to suppress weed growth naturally. Living mulches often provide better weed control as they exert strong inhibitory pressure and suppress weeds throughout the growing season (Westbrook et al., 2022). They act as a natural competitor, reducing weed seed germination by shading the soil and minimizing nutrient availability to weeds (Bhaskar et al., 2021; Petit et al., 2018).

Live mulch enhances soil structure, increases microbial activity, and improves nutrient cycling as they decompose which benefits maize plants in the long term (Ngosong et al., 2019). When choosing living mulch species for weed management, growers should consider the main crop's ability to tolerate competition. Ziyomo et al.

(2013) reported an interaction between maize hybrid and *Trifolium ambiguum* M. Bieb. control on grain yield. They found that Drought-susceptible maizehybrids showed yield reductions in a living mulch relative to a killed mulch.

Aryal (2021) revealed that, in comparison to the untreated weedy check (59.5 g m^{-2}), the dry weight of sedges was notably reduced under different weed control treatments. Specifically, live mulch, in the form of brown manuring, resulted in a sedge dry weight of 16.42 g m^{-2}, which was higher than 1 hand weeding (HW) + 2,4-D (8.05 g m^{-2}) but lower than 2 HW (18.37 g m^{-2}) and Mesotrione + Atrazine (20.45 g m^{-2}). For broadleaf weeds, brown manuring also led to a reduced dry weight of 13.64 g m^{-2} compared to the weedy check (96.02 g m^{-2}). Regarding maize yield, live mulch with brown manuring showed effective weed suppression but was less efficient than chemical herbicides and hand weeding in reducing weed dry matter and improving overall weed control.

Woghiren et al. (2021) reported that Maize and cowpea interplant at 40,000 plants/hectare suppressed weed species of the Asteraceae, Fabaceae, and Poaceae families. Weedy check accounted for the highest weed dry weight (126.30 g), while Weed Control Efficiency was highest in Maize and cowpea interplant at 40,000 plants/hectare (94.8%) and least in Weedy check (66.4%).

Plastic Mulch for Weed Management in Maize Cultivation

Plastic mulch is a highly effective weed management strategy in maize cultivation, offering both agronomic and environmental benefits. It involves covering the soil with plastic films that act as a physical barrier, preventing weed growth by blocking light and limiting the germination of weed seeds. This technique helps maintain soil moisture, regulate temperature, and enhance nutrient availability for maize plants, contributing to improved crop growth and yield (Demo & Asefa Bogale, 2024; El-Beltagi et al., 2022). Timsina (2018) found that at the tasseling-silking stage among plastic mulch treatment, higher moisture conservation on the black plastic mulch followed by clear plastic mulch, followed by green plastic mulch, and silver black plastic mulch. While comparing plastic mulch with dead mulch, moisture on dead mulch remains higher than plastic mulch after 90 DAS.

Plastic mulch significantly reduces weed density by physically preventing sunlight from reaching the soil surface, which inhibits the photosynthesis required for weed seed germination (Iqbal et al., 2020; El-Beltagi et al., 2022). This is particularly effective for controlling annual weeds and reducing the need for herbicides or manual weeding. The plastic film also prevents water loss from evaporation, retaining soil moisture for longer periods. This ensures that maize plants have a consistent supply of water, especially during dry spells, leading to better crop growth and reduced stress (Li et al., 2018; Li et al., 2020). Li et al. (2018) reported that average soil water storage during the jointing stage of maize increased by 62%, yield increased by 34%, and Water use efficiency increased by 4.1, kg hm^{-2} mm^{-1} compared with the check treatment for black plastic mulch.

By lowering fertilizer leaching, water evaporation, and weed growth, the polythene mulch enhances soil structure and microflora and raises the amount of moisture and nutrients that are available to the soil. Kulkarni et al. (1998), polythene mulch benefits maize growth, yield, and quality and helps for better soil moisture and temperature. The film plastic-mulched maize field had higher growth rates, a larger leaf area index, and a significant 28.3% increase in grain production compared to the non-mulched crop field. (Bu et al., 2013; Lee et al., 2019).

According to Grundy et al. (1996), coating the soil temporarily with black polyethylene inhibits the emergence of weeds later on, providing the crop an edge over the weeds. While clear plastic mulches work better than black plastic to warm the soil, they are ineffective at keeping weeds under control. To warm the soil, plastic mulches that selectively block off photosynthesis-active radiation (PAR) while allowing infrared light through are now available. It has been demonstrated that infrared transmission (IRT) mulches are successful in weed control (Majek & Neary, 1991). Tests have been conducted on woven and solid film polymers in a variety of colors (Horowitz, 1993). The weeds were not much affected by coverings that were white or green. Weeds were kept from growing by the use of brown, black, blue, and white on black (double-colored) films. There are hints that mulching films with a greater rate of light reflectance—such as white on black—benefit the crop (Benoit & Ceustermans, 1993). Certain insects' behavior may also be influenced by light reflectance (Lamont & Orzolek, 2004), and more colorful plastic mulches will probably become accessible in the future. Gul et al., 2011 reported that in comparison to white plastic mulch, black plastic mulch was found to be more effective.

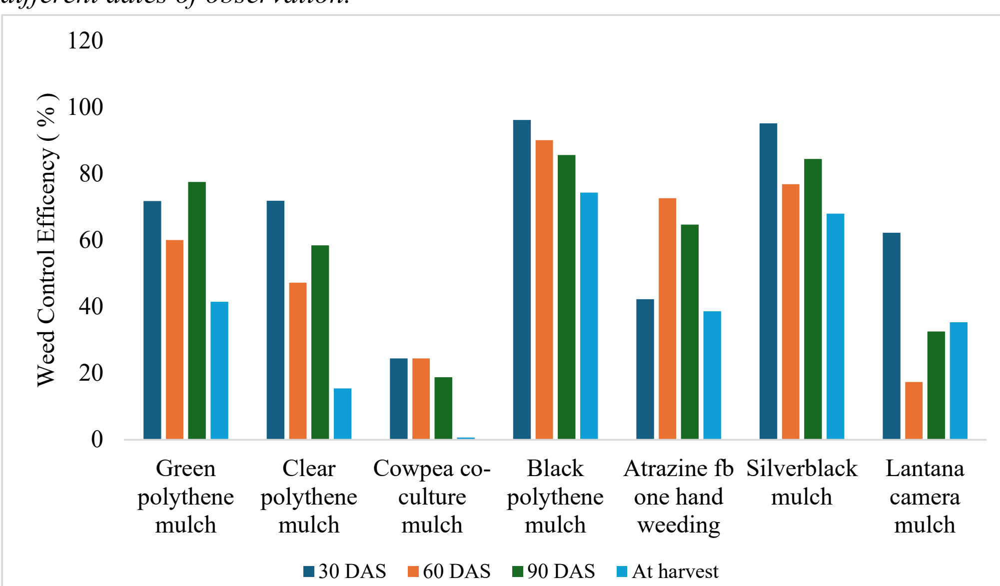
Black polythene mulch and silver black polythene mulch treated plots had the lowest weed density, weed dry weight, considerably highest weed control effectiveness, and weed control index during the whole crop season in maize (Timsina et al., 2019; Sharma et al., 2019). In the experiment, the effect of weed management practices observed on weed density and dry weight was reflected in grain yield. Mahajan et al. (2007) reported that weed density in plastic mulch (189 m^{-2}) was substantially less than that of rice straw mulch and the un-mulched treatment (539 m^{-2}). Likewise, the amount of dry matter weed found in plastic mulch (387 kg ha^{-1}) was considerably less than the amount of weed density found in un-mulched treatment (618 and 107 kg ha^{-1}) and rice straw mulch (618 and 107 kg ha^{-1}). Similarly, Abdullahi et al. (2016) found black polythene mulch had the lowest weed density (61 weeds m^{-2}) which remains at par with paddy straw mulching (61 weeds m^{-2}). Additionally, Rajablarijani et al. (2014) reported weeds in sweet maize were reduced by 94.7% when black plastic mulch was used.

Sun et al. (2015) and Rajablariani and Sheykhmohamady (2015), observed that plots covered with black plastic mulch displayed noticeably less weed infestation as compared to the control film. Plots wrapped with black film had the least amount of weed infestation. Gul et al. (2009) found fresh weed biomass measured after manual weeding (112 kg ha-1) was significantly lower than weed mulch (164 kg ha-1), live mulch (195 kg ha-1), white mulch (191 kg ha-1), and weedy check (240 kg ha-1). It was also significantly at par with black plastic mulch (120 kg ha-1).

In comparison to weedy plots in the production of sweet maize, black plastic mulch satisfactorily offered 92 to 93% weed control(Mirshekari et al. 2012). According to Kahangi et al. (2014), living mulch also reduced weed growth by 54–66%, although plastic mulch treatments had the lowest weed biomass measured. Olabode & Sangodele (2015) discovered that the following order of weed control methods were effective: white plastic, black plastic, atrazine, hoe weeding, grass mulch, and weedy check. According to Zhang et al. (2008), black plastic film mulch eliminated all weeds in maize. Rajablarijani et al. (2014), the mulch treatment and seeding date had a substantial impact on the overall dry weights of weeds. According to Zhang et al. (1992), black plastic mulch eradicated all weeds in tomato and corn plants.

Figure 1

Weed control efficiency of different colour polythene and biological mulch in maize at different dates of observation.



Source: (Timsina et al., 2018)

Live Mulch, Dead Mulch, and Plastic Mulching on Maize Yield Parameters and Grain Yield

Live Mulch

Tushar (2022) reported the highest grain yield (9.37 t ha^{-1}), stover yield (17.11 t ha^{-1}), and biological yield (26.48 t ha^{-1}) in a maize + soybean + grasspea intercropping system. Similarly, Talebbeigi and Ghadiri (2012) found that cowpea living mulch, at a density of 22 plants m^{-2}, significantly increased maize grain yield in both years of study. Oyeogbe et al. (2017) observed a 25% increase in maize yield when grown with cowpea live mulch. Additionally, Aladesanwa and Adigun (2008) identified sweet potato as an effective live mulch, suppressing weeds and improving maize growth and yield. Numerous studies emphasize the role of live mulch, especially leguminous cover crops, in enhancing soil fertility through nitrogen fixation, improving plant growth, increasing kernel weight, longer cob length, and a higher number of grains per cob. Overall, live mulch is recognized as a sustainable approach to boosting maize productivity while reducing the dependence on chemical inputs.

Dead Mulch

Dead mulch has been widely reported to positively impact maize yield parameters, including plant height, cob length, kernel number per cob, and 100-grain weight. Nyasasi and Kisetu (2014) observed a 10-20% improvement in these parameters in maize grown with dead mulch compared to control plots, attributing the yield increase to enhanced soil moisture and fertility. This led to a 22% rise in grain yield. Niang et al. (1996), over two growing seasons, found that *Lantana camara* mulch produced the highest grain yield (4.84 t ha^{-1}), followed by *Tithonia diversifolia* (4.29 t ha^{-1}), *Psidium guajava* (3.43 t ha^{-1}), *Calliandra calothyrsus* (2.71 t ha^{-1}), *Senna spectabilis* (2.31 t ha^{-1}), and *Grevillea robusta* (1.69 t ha^{-1}). The control group, by contrast, had the lowest yield (1.01 t ha^{-1}).

Similarly, Khurshid et al. (2006) demonstrated that plastic mulch increased maize yield by 30% compared to bare soil. The mulch not only conserved moisture but also moderated soil temperature, creating optimal conditions for maize growth. As a result, plants in mulched plots exhibited taller growth, longer cobs, and a higher kernel count per cob, all contributing to higher grain yield. Dead mulch is also recognized for its long-term benefits in maize productivity. Lal (2000) noted that continuous use of organic mulch improves soil health over time, promoting sustained yield increases by enhancing organic matter content and reducing erosion. Mulumba and Lal (2008) similarly reported that straw mulch improved maize yield parameters such as plant height, cob size, and grain weight. Ram et al. (2012) observed a 15% increase in cob length and a 10% increase in 100-grain weight in mulched plots compared to non-mulched ones. Marahatta (2020) further confirmed that maize grown under straw mulch exhibited significantly higher kernel numbers per cob and thousand-kernel weight than in no-mulch treatments.

Plastic Mulch

Timsina et al. (2019) reported that the highest maize grain yield was recorded in silver black plastic mulch (4537.50 kg ha^{-1}), followed by black plastic mulch (4068.20 kg ha^{-1}), clear plastic mulch (4065.22 kg ha^{-1}), green plastic mulch (3834.84 kg ha^{-1}), and weed-free (3222.74 kg ha^{-1}), which were comparable to each other. The results showed that various yield attributes, such as ear harvested per hectare, number of grains per ear, and 1000 grains weight per cob were significantly affected by the different colors of plastic mulch which ultimately affected the yield. A higher thousand-grain weight was obtained in green polythene mulch (309.62 g), statistically similar to black, silver black, and clear polythene mulch-treated plots. Similarly, the lowest sterility percentage (15.11%) was recorded in the black polythene mulch-treated plot.

Li et al. (2020) reported that plastic mulch significantly increases the grain yield. Similarly, Bu et al. (2013) stated that grain yield measured with plastic mulching (13.71 t ha^{-1}) was found to be significantly greater than grain yield measured with gravel mulching (12.51 t ha^{-1}) and without mulch cropping (10.69 t ha^{-1}).

As reported by Mirshekari et al. (2012), during the two years of the experiment in 2010 and 2011, respectively, the highest kernel yield was recorded in the black plastic mulch (10.67 t ha^{-1} and 6.72 t ha^{-1}) compared to the biodegradable mulch (6.04 t ha^{-1} and 4.58 t ha^{-1}). The weedy check plot recorded the lowest kernel yield (3.13 t ha^{-1} and 2.55 t ha^{-1}).

Khan et al. (2011) reported that the weedy check plots had the lowest yield (1.36 t ha^{-1}), while polyethylene (black) and polyethylene (white) had the highest grain yields (2.48 and 2.03 t ha^{-1}). Zandstra et al. (2009) found that transparent plastic mulch enhanced the marketable yield of sweet corn by 25% to 63% compared to bare soil. According to Khurshid et al. (2006), plastic mulch treatment increased plant height, total dry matter, number of grains per cob, thousand-grain weight, and grain yield of maize.

Ali et al. (2011) reported that higher grain was recorded in black plastic mulch (3.54 t ha^{-1}) compared to wheat straw mulch (3.32 t ha^{-1}) and newspaper mulch (3.021 t ha^{-1}). Similarly, Gosavi (2006) revealed that the green cob and stover yields under polythene mulch were considerably higher than those under control at 23.51 t ha^{-1} and 24.67 and 30.36 t ha^{-1} respectively.

Conclusion

Numerous studies have identified weeds as a significant contributor to yield reduction in maize cultivation. Effective weed management hinges on targeting the critical period of crop-weed competition. Both live and dead mulch systems have proven successful in suppressing weed biomass and reducing weed diversity across successive maize-growing seasons, ultimately enhancing grain yield. Given the sustainable use of natural resources, various biological and plastic mulching techniques can serve as viable alternatives to herbicides, effectively controlling weed proliferation while maintaining optimal soil temperature and moisture levels.

Conflict of Interest

The author reported no potential conflict of interest.

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