Review of the impact of drip irrigation mulching on soil characteristics and efficiency in water usage

Abstract

Vegetable growth and productivity are influenced by watering techniques and different kinds of mulch. The current study reviewed drip irrigation that used different irrigation volumes (V, 0.7V, and 0.9V) in drip treatments.. Transparent mulch resulted in higher soil temperatures compared to black mulch. The study or situation involved the use of black mulch, which is a type of mulching material often used in agriculture. The use of black mulch caused the soil temperature to rise. The increase in soil temperature ranged from 2.6 to 5.5 degrees Celsius (°C). This indicates a considerable temperature difference. The moisture content in the non-mulched plots was found to be higher than that in the mulched ones. The utilization of plastic mulch resulted in water conservation ranging from 26% to 36% across various treatment conditions. In comparison to the control treatment, all treatment groups that used black mulch saw increased yields.. By maximising water use, the use of mulching and drip irrigation in vegetable cultivation offers the potential to lower cultivation costs

Keywords: Drip irrigation, water conservation, mulching

Introduction

Water is an indispensable and pivotal component for sustaining human life, particularly in developing nations such as India. Due to the consequences of global warming and the unpredictable patterns of rainfall in arid and semi-arid regions, the availability of water resources for agricultural uses has been limited recently (Kader et al., 2019). Water, although considered a renewable resource, is currently facing significant challenges in terms of its availability in suitable quantities and quality. These challenges arise from the escalating global population and the expanding demand for water across all industries. The agricultural sector is the primary consumer of water, accounting for around 85% of total water usage, primarily for irrigation purposes. India, which has 19% of the world's population but only 3.5% of the world's land and 5% of its water resources, places paramount priority on the optimal use of such resources

Water scarcity is a significant concern to the global community in the 21st century.

Water scarcity and pollution are major problems now in many parts of the world due to poor management of nutrients and water. This poor management also creates a significant obstacle to preserving environmental sustainability and ensuring future food security. Compared to modern watering methods like drip, micro-jet, micro sprinkler, and overhead sprinkler, surface irrigation is far less efficient.

Water is a crucial resource for agricultural activities, and as farming methods become more intensive, the scarcity of water sources is accelerating.

Due to the enormous improvements in agriculture and industry over the past few years, there has been a greater escalation in water scarcity. Despite the fact that water supplies are naturally limited, inefficient water use is a common problem. Approximately 84% of all water usage is accounted for by the agriculture sector. Between 50 and 70 percent of the water used by conventional irrigation techniques is lost through transpiration, evaporation, field application losses, and distribution losses. These losses can be decreased by using efficient water management strategies, mulching, and modern watering methods like drip irrigation. In the context of India, it is projected that by the year 2030, the demand for water will increase to approximately 1500 billion cubic meters. This increase in demand can be attributed to the need for producing more food grains in order to sustain the expanding population.

India's water resources are indeed a matter of concern due to various factors such as population growth, industrialization, and climate change. As of my last knowledge update in 2021, India was facing water stress, with some regions experiencing water scarcity issues. The total annual freshwater availability in India is influenced by factors like rainfall, rivers, and groundwater, and it can vary from year to year.

Efficient water management practices are crucial to ensure sustainable water use, especially in agriculture, which is a major consumer of water in India. Crop water productivity refers to the efficiency of water use in agriculture to produce crops, and adopting advanced technologies and irrigation practices can help improve crop water productivity. Techniques like drip irrigation,

rainwater harvesting, and the use of water-efficient crop varieties have been promoted to address water scarcity issues in agriculture.

I suggest referring to recent official publications, scholarly research, or other news sources to gain the most up-to-date information about India's water supply and water management activities. The references you cited from Jeelani et al. (2017) and Kumari et al. (2018) may offer detailed insights on the situation with regard to India's water resources and methods of water management at the time of their publication.Drip irrigation, which distributes water in small, targeted amounts, is a particularly efficient method of hydrating plants. This process comprises releasing water gradually, drop by drop, onto or just below the soil surface, close to the plant's root zone, either in a specific spot or in a grid-like pattern. Due to its ability to efficiently manage and optimise the allocation of both water and fertiliser resources, this approach is widely used in a variety of scenarios (Rajurkar et al., 2012). When making decisions aimed at maximising crop yields and improving overall produce quality, the implementation of an effective irrigation schedule is of the utmost importance..

The effective implementation of irrigation scheduling necessitates a comprehensive understanding of crop attributes, including the specific water requirements of a certain crop at a particular stage of growth, as well as the appropriate methods for water application.

In addition to the aspects already mentioned, it's critical to assess water usage efficiency (WUE), which measures how effectively water is delivered to a crop's potential root zone for optimum plant growth (Jeelani et al., 2017). There are two ways to improve the water use efficiency (WUE): either by boosting crop transpiration or by increasing yield per unit of water used. The maximization of WUE can be achieved by the use of many strategies, including deficit irrigation, the utilization of advanced irrigation technology, and the implementation of effective irrigation Scheduling. Additionally, enhancing agricultural water management techniques can contribute to the improvement of crop yields, hence, further enhancing WUE. The utilization of this technique in plant management has the potential to enhance both crop output and product quality. Hence, it is imperative to enhance water use efficiency (WUE) by reducing the amount of water used while maintainingthe agricultural output, particularly in locations with limited water resources. Numerous complex factors influence how the irrigation schedule, which determines when and how much irrigation water is used, is decided. Microclimate, however, acquires a crucial relevance among these variables.

Mulching is one of the water management techniques intended to improve WUE. Sand, grass, gravel, grass, and plastic film are just a few of the elements that have been used to make mulch in the past (Sweeny et al., 1987; Kader et al., 2019). Mulching is a technique that, among other things, has been demonstrated to have a positive impact on soil productivity and weed control, which in turn improves crop yield. Certain mulching advantages may vary depending on the type of mulch used (Asiegbu, 1991). There is proof from past studies that polyethylene mulch is used in vegetable gardens.The utilization of soil cover and mulching is widely recognized for its advantageous effects on soil moisture retention, Solarization, and weed management. According to Arora et al. (2008), this phenomena also results in increased levels of carbon dioxide near plants, a conservation of moisture, and a reduction in soil compaction. Kader et al. (2019) claim that using plastic mulch causes elevated soil temperatures to be maintained over the course of the night, fostering ideal circumstances for root activity. Furthermore, it has been demonstrated that this method reduces the population of undesired plant species and improves soil microbiological activities by fostering a more favourable environment close to the root zone. By increasing the amount of organic matter in the soil, mulches can increase the soil's capacity to hold water. Mulches need to be applied frequently. Therefore, it has been advised that mulching techniques be used in vegetable production due to its benefits, particularly its capacity to control soil temperature and conserve soil moisture in diverse agro-climatic areasThis method seeks to lower cultivation costs and provide yields of superior quality, resulting in bigger financial returns. For high-value crops like tomatoes and cucumbers, covering the ground with thick paper or plastic sheets proves out to be a financially viable alternative. This method preserves water, safeguards the soil, and stops unwanted plants from growing. The use of mulch in conjunction with micro irrigation is shown in Figure 1.

Table 1 presents the impact of various mulches and irrigation amounts on the moisture content.

S.No	Study	Outcomes	References
01	**Studied the effect on Soil Moisture,temperature and Sugar Metabolism in Japanese radish (RaphanusSativus)**	**Higher Soil Moisture Content in Mulched Plots throughout the experimental Period.**	**Anutin et al. (2011)**
02	**Studied the effect on Soil moisture , Extraction pattern & different Irrigation Schedules in summer Ground nut.**	**Soil moisture contents were found maximum (26.69 and 23.19)% at 40 mm followed by 26.10 & 22.96% at 50 mm Crop Evapotranspiration and 15-30cm Soil depth. For deeper layers , the maximum Soil Moisture Contents were found 17.31 & 14.48 % at 60mm crop evapotranspiration at 45-60 and 60-75 cm Soil depth respectively.**	**Patel et al .(2012)**
03	**Studied the effect on Soil moisture using different Mulching (black plastic mulch, Paddy Straw).**	**The results revealed that the soil moisture content was found at 10 cm depth as compared to 30 cm depth under black plastic and paddy straw muscles .**	**Deshmukh et al (2013)**
04	**Studied the effect on Soil moisture using different mulching in Strawberry Cultivation.**	**The highest moisture content were ranged from 1 to 2.6 %.Black as well as white polythene Mulches Conserved higher soil Moisture Contents.**	**Pandey et al (2016).**
05	**Studied the effect on Soil moisture using differernt mulching in gladious Cultivation.**	**The highest moisture content were ranged from 19 to 26 %. The black polyethylene mulching with drip irrigation Significantly help to conserve soil moisture.**	**Salma et al . (2016)**
06	**Studied the influence of two plastic mulches (transparent and black)and three wetted Soil % ages (35,55and**	**Wetted Soil treatment (35%) had more root development.Evapotranspirationrate was increased with increase in wetted Soil %.**	**Zhang et al. (2019)**

	75%) on potato root distribution ,evapotranspiration,tuber yield and quality and water use efficiency.		
07	**Evaluated theeffect of drip irrigation levels at 0.4 CPE, 0.6CPE & 0.8CPE and fertilizer application methods on growth , quality parameters, productivity and nutrient uptake of broccoli**	**The results indicated that 0.8 CPE had higher Soil water Content in Comparison to 0.4 CPE & 0.6 CPE. The treatment 0.8 CPE obtained better marketable curd yield due to favourable Soil moisture regimes under the treatment.**	**Jeelani et al (2020)**

Fig 1.Utilization of mulch in conjunction with micro irrigation.

Mulching at a field

Plant development and the impact of various mulches and irrigation intensities

The moisture content of the soil has a big impact on how much and how well crops produce.

The impact of applied mineral fertilisers on the crop is increased by adequate soil moisture during critical phases of plant development in addition to improving metabolic processes within plant cells. According to Saif et al. (2011), any level of water stress may have a negative impact on the crop's growth and output.

Japanese Radish (Raphanussativus) impacts on soil moisture, temperature, and sugar metabolism were all studied by Anutin et al. in 2012. Throughout the course of the trial, the researchers noticed that the soil moisture levels of the mulched plots were consistently greater than those of the unmulched plots. The pattern of moisture extraction from the summer groundnut was observed to be affected by various irrigation schedules. The soil moisture contents were found to be maximum at 50 mm irrigation, with values of 29.66% and 25.18%, for the 0-17 cm and 17-32 cm soil depths, respectively. The values that followed for the corresponding soil depths were 25.27% and 22.76% at 50 mm of crop evapotranspiration and 28.10% and 24.98% at 60 mm of crop evapotranspiration, respectively (Patel et al., 2008). Deshmukh et al. (2013) discovered that paddy straw mulch had the second-highest soil moisture content, followed by black plastic mulch, and that the treatment without any mulch had the lowest soil moisture content.

According to El-Zohiri et al. (2013), potato crops in mulched plots had higher soil moisture levels than those in unmulched plots. In comparison to the red polyethylene mulch, which had the highest moisture content of 25.45%, the black polythene mulch had a slightly lower moisture content of 25.75%. The blue plastic mulch had the least amount of moisture of the three, at 25.88%.

Bare soil had the lowest moisture content, coming in at 16.52%, according to El-Zohiri et al.'s (2013) study. In their 2014 study, Taparauskiene and Miseckaite discovered significant variations in soil moisture levels, demonstrating the value of mulching the top soil layer to promote strawberry development and boost fruit yield. According to a study done by Taparauskiene and Miseckaite (2014), the condition with the most soil moisture content was the one with straw mulch (18.0%). Next was the condition with the black polyethylene mulch, which had a soil moisture content of 15.5%. In contrast, the lowest soil moisture content of 17.2% was discovered without mulching at a soil depth of 0–45 cm.

In their research, Zhang et al. (2017) examined the effects of three soil moisture content levels—45%, 65%, and 85%—as well as two different types of plastic mulches—transparent and black—on different aspects of potato growth, including root distribution, evapotranspiration, tuber production and quality, as well as water use efficiency.

The treatment involving 85% wetted soil exhibited significantly higher evapotranspiration rates compared to the treatment involving 45% wetted soil, which had the lowest evapotranspiration rates. Therefore, it can be observed that there was a positive correlation between the wetted soil percentage and the evapotranspiration rate.

The effect of various irrigation levels on soil temperature

A key factor in controlling microbial activity and various procedures involved in the establishment and growth of plant life is the thermal regime of the soil, as indicated by soil temperature. Mulching with plastic film has been found to raise the temperature of the soil's surface. Its impact on the heat balance, which causes an increase in soil temperature, is attributable to this effect. Additionally, it has been discovered that using plastic film mulching has a positive effect on crop emergence.Depending on the particular colour of the plastic mulches used, the soil temperature beneath plastic film frequently reaches high levels and varies. Various kinds of mulch materials have been demonstrated to have varied effects on soil temperature, according to a study done by Ramakrishna et al. (2006). At depths of 5 cm and 10 cm, respectively, the use of polythene mulch resulted in rises of about 6.8°C and 4.8°C. The effects of synthetic (black and white polyethylene) and organic mulches on the soil hydrothermal regimes in brinjal were evaluated by Singh et al. (2006).

When using organic mulches, the researchers observed a range of soil temperatures between 7.8 and 13.63°C, and between 3.86 and 8.97°C when using synthetic mulches.

The mulch materials exhibited a favourable moderation of soil temperature in comparison to the unmulched treatment.

Singh and Kamal (2012) found that the temperature difference between mulched and bare soil varied from 2.2 to 3.4°C. Singh and Kamal (2012) found that the minimum soil temperature was highest at a depth of 10 cm, compared to a depth of 5 cm beneath black plastic mulch. Additionally, the lowest minimum soil temperature ever recorded was caused by the absence of mulch. In their 2013 study, El-Zohiri et al. investigated the effects of coloured plastic mulches on soil temperature when growing potatoes, focusing on black, red, and blue. The temperature of the soil fluctuated at a depth of 10 cm due to the presence of coloured mulches. differences in temperature between the mulched and control plots.

Sharma and Meshram (2015) discovered that, on average, the soil temperature under black plastic mulch was 1.31°C and 1.93°C higher than the temperatures seen under paddy straw mulch and without any mulch, respectively.

The average maximum soil temperature in the capsicum crop, according to Sharma and Meshram (2015), increased dramatically by 4.6°C as a result of the usage of black plastic mulch. When paddy straw mulching was utilised instead of no mulching, rises of 1.62°C and no increase, respectively, were obtained.

Singh and Ghosal (2015) reported that the polyethylene mulch treatment exhibited the greatest soil temperature, ranging from 21.9 to 22.9°C. In comparison, the control treatment showed somewhat lower soil temperatures. The grass mulch treatment, on the other hand, recorded the lowest soil temperature, ranging from 19.1 to 21.6°C. These temperature readings were made in soil that was 0 to 60 cm deep. The surface and the first 15 cm of soil beneath black plastic mulch had the highest mean minimum soil temperatures, at 20.6°C and 22.6°C, respectively, according to Rana et al.'s (2015) study.

According to Pandey et al. (2016), the highest soil temperature was recorded when black plastic mulch was used, followed by plastic mulch, and the lowest soil temperature was recorded when rice husk mulch was used in strawberry production. In a study by Reddy et al. (2017), the mean soil temperature at a depth of 15 cm varied in the control plot from 13.5 to 27.5°C. While black plastic mulch was there the entire winter season, the temperature ranged from 15 to 31.5°C.

When black plastic mulch was used, the temperature at different depths during the summer months ranged from 15 to 35°C, whereas the control plot in turmeric saw a temperature range of 14.5 to 32.5°C.

In a study by Job et al. (2018), it was found that when mulch was spread, the soil temperature at a depth of 5 cm was measured to be 22.3°C. In contrast, when there was no mulch, the temperature plummeted to a minimum of 20.6°C. Similarly, the soil temperature was found to be 21.8°C with mulch and 18.6°C without mulch at a depth of 10 cm.

The impact of drip fertigation and mulch on the availability of soil nutrients.

The utilization of drip irrigation in combination with plastic mulch enables the preservation of water and fertilizers. Drip irrigation is a method that involves the application of a reduced quantity of water, together with fertilizers, at regular intervals directly to the root zone, in accordance with the plants' specific water requirements. In comparison to the broadcasted method of fertilisation, the use of this technique reduces the amount of fertiliser that is applied (Yaseen et al., 2014). When drip irrigation is used in conjunction with plastic mulch, additional benefits such as fertiliser and water saving are also provided in addition to higher crop yield (Moreno and Moreno, 2008). The effect of mulching on the physical characteristics of soil was investigated, according to a study by Mulumba and Lal (2008). The application of mulch, according to the researchers, increased the amount of water that was readily available by anywhere between 18% and 35%. With an improvement ranging from 29% to 70%, the soil moisture retention at low suctions also significantly improved.

After being covered with plastic mulch, the soil's levels of organic carbon, organic matter, accessible potassium, accessible phosphorus, total nitrogen content, and C:N ratio improved, according to Tiwari et al. (2014), who conducted the soil study. polythene, and white polythene) on various soil chemical characteristics. In their research, Pandey et al. (2016) found that areas with black polythene mulch had lower soil pH (8.49), accessible phosphorus (39.4 kg ha-1), and available potassium (478.3 kg ha-1) values than those without it. The effect of several mulching techniques on cauliflower growing in Nauni, Himachal Pradesh, was studied. It was found that regions where rice husk mulch was applied had the highest soil organic carbon content (0.66%) and accessible nitrogen (426.5 kg ha-1).

In comparison to the other treatments, the experimental results showed that the black plastic mulch treatment had the highest levels of readily available nutrients, specifically N (353.8 kg ha-1), P (48.9 kg ha-1), K (261.8 kg ha-1), Ca (702.3 kg ha-1), Mg (430.8 g ha-1), and (SO4)2 -S (67.7 kg ha-1). The percentage increases in nitrogen (3.6-4.1%), phosphorus (27.6-35.1%), potassium (3.4-3.7%), and calcium (1.3%) availability from their initial values were noted. However, it was established that organic mulching, particularly the use of grass and pine needle mulch, led to a higher level of soil organic carbon.

The impact on the absorption of Nutrients:

Achieving optimal crop development and productivity depends on the soil and plants having enough nutrients. In comparison to surface irrigation with conventional fertilisation, drip fertigation has been reported to produce a fertiliser use efficiency of over 90%, beyond the 40–60% efficiency generally observed.

Additionally, fertigation effectively maintains high levels of nutrient concentrations in the soil's topmost layer, which is the key area for plant water absorption and nutrient uptake. As a result, this technique greatly improves nutrient utilisation efficiency. A sophisticated way for understanding how plants develop and what physiological processes they go through at different phases of growth is the use of soil and plant analysis (Sahana et al., 2018). In their study, Kumar and Dey (2011) assessed how different mulches affected the way strawberry plants absorbed nutrients. The main focus of the study was on the impact of mulches on drip irrigation and surface irrigation systems.

The rates of nitrogen absorption for drip irrigation and surface watering increased by 189.20% and 85.80%, respectively, when mulch was utilised Drip irrigation was used instead of surface irrigation, which resulted in a 55% reduction in water use for irrigation while also increasing fruit yield by a rate of 21.

The effects of various nitrogen rates (0 kg ha-1, 69 kg ha-1, 108 kg ha-1, and 155 kg ha-1) and irrigation levels (125 percent, 110 percent, and 60 percent of crop evapotranspiration) on the nitrogen uptake and water usage efficiency of shallot were examined in a study by Kemal (2013)..

At a rate equal to 110% of the crop's evapotranspiration, irrigation was set up. There was an option to apply 110 or 155 kg ha-1 of fertiliser. The significant crop growth was shown by the significant total nitrogen intake of 38.18 kg ha-1. The sapota leaf sample treated with 85% drip irrigation and mulch had the highest quantities of nitrogen (1.48%), phosphorus (0.066%), and potassium (0.78%), per Tiwari et al.'s (2014) study.

The leaf sample treated with 100% drip irrigation in a ring basin had the lowest N content (1.36%), P concentration (0.039%), and K concentration (0.43%), according to Tiwari et al.'s (2014) study. According to a study by Fura (2014), at an irrigation level of 122% crop evapotranspiration, the highest nitrogen concentrations were found to be in the leaves

(1.37%), bulbs (1.78%), and overall (3.13%). Additionally, this irrigation level resulted in a 40.68 kg ha-1 total nitrogen intake, of which 35.6 kg ha-1 came from bulbs and 5.08 kg ha-1 came from leaves.

The lowest nitrogen concentration, according to Alam et al. (2016), was found in the leaves at 1.13%, while the nitrogen concentration in the bulbs was 1.58%. In addition, it was found that the nitrogen absorption of the leaves was much lower than that of the bulbs, which was found to be 12.03 kg ha-1. Nitrogen was ingested in an amount of 14.03 kg ha-1. A 50% crop evapotranspiration irrigation level was used to make these observations. In a 2018 study by Jha et al., the cauliflower crop was found to have the highest nitrogen uptake (172 kg ha-1), phosphorus uptake (17.13 kg ha-1), and potassium uptake (117 kg ha-1) of any crop. According to Sahana et al.'s (2018) research, pole bean plants grown in poly houses contained the greatest nutrients in their leaves.Further investigation revealed the following nutritional values: nitrogen (0.88%), potassium (0.21%), iron (396 ppm), manganese (235 ppm), zinc (89.87 ppm), and copper (15.88 ppm).

The maximum phosphorus content was found in the leaves, where it was found to be 0.75 percent, while using 81% of the recommended fertiliser dose (51.42:82:63 N, P2O5, and K2O kg ha-1), a water-soluble fertiliser combination, mulching, and a micronutrient spray (0.55%).

Growth of plants and the subsequent output of crops

The role of irrigation on agricultural output is significant, as it is linked to various aspects within the plant's environment that impact its growth and development. In situations where water availability is restricted, farmers have a tendency to extend the duration between irrigation events. This practice leads to water stress, which in turn negatively impacts crop yields and diminishes their quality. Drip irrigation has garnered attention due to its capacity to deliver small and frequent water applications in close proximity to the plant root zone. This method has been of interest due to its potential to reduce water requirements and potentially enhance production (Jain et al., 2000According to a study by Jilani et al. (2010), the highest reported values for a variety of plant characteristics were obtained when 200 kg ha-1 of nitrogen (N) was supplied. These included the yield (99.88 t ha-1), the number of leaves (18.70), the length (33.33 cm), the weight (160.67 g), and the diameter (4.87 cm) of the roots.

Inusah et al. (2013) examined how the growth of onions in a tropical setting was impacted by various organic mulches, particularly grass and rice straw. Of all the treatments, the grass mulch treatment's bulbs were the largest in terms of diameter (5.71 cm), weight (175.16 g), and yield (10.58 tha-1). Following that, the rice straw mulch treatment yielded 6.63 t ha-1. The reported lowest yield was 3.20 t ha-1.

Begum and Saikia (2014) have demonstrated through their research that a variety of plant traits are significantly influenced by the timing of irrigation application. The highest plant height (56.13 cm), leaf count (60.60), and tuber yield (18.03 t ha-1) were reported, especially when irrigation was provided at crucial times. After that, 25 millimetres of irrigation per minute of crop evapotranspiration was applied.At a crop evapotranspiration of 30 mm, the plant produced the least quantity of tubers (15.43 t ha-1), had the fewest leaves (55.80), and was the smallest in height (51.73 cm). In order to assess the effects of deploying an air injector in a subsurface drip irrigation system, Vivek et al. (2015) examined the productivity and yield of radish crops. In their study, Kumar et al. (2016) examined the effects of various irrigation levels on brinjal plants. They found that the optimum fruit output (10.74 kg ha-1) and highest fruit length (13 cm), fruit diameter (6.7 cm), and weight (57 g) values occurred when 80% of the plants were watered by drip irrigation.For fruit length (9.5 cm), fruit diameter (6.0 cm), fruit weight (52 g), fruit yield (790.0 g plant-1), and fruit yield (6.25 kg ha-1), 50% drip irrigation yielded the worst results. The results of Reddy et al. (2017) show that the treatment utilising 0.8 volume with drip watering and mulch gave the greatest readings for a number of turmeric plant attributes. The maximum plant height was 139.4 cm, the stem girth was 10.81 cm, the number of functional leaves was 11.41, the weight of the corm was 863.5 g, the length of the corm was 11.72 cm, and the yield was 16.64 t ha-1. with contrast, the furrow fertigation strategy resulted with the lowest results for these features.

Islam and Zaman studied the way various irrigation intervals affected the growth of garlic in their 2017 study. The results showed that the maximum bulb yield of 10.48 t ha-1 was obtained with an irrigation interval of 10 days and a seasonal water use total of 372 mm. The 15-day irrigation interval produced a bulb yield of 9.81 t ha-1 utilising 275 mm of seasonal water. The investigation of bulb production of 8.0 t ha-1 over the irrigation interval of 25 days showed the lowest yield during that time

The objective of the study by Araujo et al. (2018) was to evaluate radish growth at various irrigation levels ranging from 50% to 150% of the reference evapotranspiration (ETo). The trial also looked at four types of soil cover, including mulching, wood shavings, and rice hulls. With the exception of the front root's dry mass, all of the variables under investigation showed a statistically significant change when compared to the irrigation slides. Additionally, when the reference value of 150% ETo was used, the highest productivity was 700.07 q ha-1.

The potato crop was irrigated often at a cumulative pan evaporation (CPE) of 35 mm, and it was able to produce a maximum yield of 22.63 t ha-1, according to Dash et al. (2018). The least amount of material was produced, 4.62 t ha-1, by the control group. In their study, Rannu et al. (2018) examined the impact of mulch and irrigation on the typical strawberry fruit diameter. The researchers discovered that when rice straw mulch was sprayed with irrigation at intervals of five days, the largest fruit diameter (3.37 cm) was measured. After that, black mulch was placed, and watering was timed to follow. However, when irrigation was sprayed over rice straw mulch at intervals of fifteen days, the smallest fruit diameter (3.01 cm) was observed.

Use of water wisely

"Water use efficiency" (WUE) is a broad topic with numerous definitions. The quantity of crop that can be harvested utilising irrigation, rainfall, and soil water storage that feeds the crop with water is considered by farmers and farm managers to be a measure of water use efficiency (Singh et al., 2009). Most often, efficient water usage is seen as a crucial element of crop drought resistance and a factor in output under pressure. The phrase "more crop per drop" has been used to imply that plants that get their water from the rain can produce more stuff with each unit of water they use.." According to Kang and Wan (2005), it has been shown that the different soil water potential (SWP) treatments have an impact on radish evapotranspiration (ET) and water usage efficiency (WUE).

Furrow irrigation had the lowest water consumption efficiency, according to Kashyap et al. (2009), and 60% drip irrigation with mulch had the highest (4.11 t ha-1). According to Singh et al. (2009), surface irrigation had the lowest water use efficiency (0.42 t ha-1 cm-1) and applied 70 cm of water, while 80% drip irrigation with mulch had the greatest (1.34 t ha-1 cm-1) and applied 52.87 cm.

Paddy straw mulching produced the highest water use efficiency (5.81 t ha-1 cm-1) and the lowest water use efficiency (592 kg ha-1 mm-1) at irrigation levels that were 50% greater than crop evapotranspiration, according to research by Biswas et al. (2015).

The average seasonal water use for each drip treatment was 137 mm, 206 mm, and 274 mm, respectively, at irrigation levels of 50%, 75%, and 100%. Mulches with irrigation level showed improved water use efficiency under all irrigation levels.

When water was supplied at a depth of 43.1 cm, Reddy et al. (2015) discovered that drip irrigation with mulch and trellising had the highest water use efficiency (1.46 t ha-1 cm-1) and the lowest (0.47 t ha-1 cm-1). Mulch irrigation using drip systems and this application of water depth came in second. When irrigation and fertigation were applied every two days and twice a month, respectively, brinjal showed the highest water use efficiency (4.65 Mg m-3) and the lowest (2.24 Mg m-3), according to Saroch et al. (2016).

Among all the materials employed in a Chrysanthemum experiment, polythene mulch had the highest water use efficiency (114.5 kg ha-1 mm-1), according to Jawaharlal et al. (2021). The 65% drip irrigation level (114.09 kg ha-1 mm-1) was found to have the maximum water consumption efficiency. The absence of mulch was found to contain the least quantity (91.43 kg ha-1 mm-1) (Jawaharlal et al., 2021; Agrawal et al., 2018). Crop pan evaporation 30 has the lowest water use efficiency, according to Dash et al. (2018), followed by crop pan evaporation 55 (47.4 kg ha-1 mm-1). The best water use efficiency was achieved by the control treatment (47.8 kg ha-1 mm-1).

Using entire leaves as mulch and fertiliser, Carvalho et al. (2018) found that the maximum water use efficiency (48.01 kg m-3) was attained at 131.9 mm water depth. The next thing I noticed was a water depth of 131.9 mm, a mulch of whole leaves, and no fertiliser. When papaya was grown in plastic mulch, black plastic mulch came in second with a WUE of 336.03 kg ha-1 mm-1, whereas the control treatment produced the lowest WUE of 164.12 kg ha-1 mm-1 (Sakariya et al., 2018).

Price economics

Water is the main barrier to crop diversity and productivity. As a result, drip irrigation attempts to achieve irrigation's maximum water use efficiency, which is essential for the effective use of scarce water resources for crop production and economic gains. It is important to take into account drip irrigation's benefits, including the reduction of water and nutrient use, enhanced yield and cultivation intensity, and a higher benefit-to-cost ratio (Fanish, 2013). According to Singh et al. (2011), 100% drip irrigation with mulch was followed by 85% drip irrigation with mulch to produce the highest Gross return (101273 Rs ha-1), Net return (51387 Rs ha-1), and benefit cost ratio (2.05).At 60% trickling irrigation with mulch for tomatoes, the lowest Gross return (60411 Rs ha-1), Net return (15409 Rs ha-1), and Benefit Cost Ratio (1.33) were noted. In an experiment on maize, Fanish (2013) found that drip fertigation of various treatments resulted in the highest cultivation costs (26014 Rs ha-1), Net returns (46,987Rs ha-1) and B:C ratios (2.81). The economic benefits of mulching onions showed that grass straw mulch had the highest benefit-cost ratio of 2.33, followed by rice straw mulch (1.08), and that no mulching had the lowest benefit-cost ratio of 0.05 (Inusah et al., 2013).

Conclusion

Mulch is advantageous when used with trickle irrigation since it increases output in addition to water conservation. Based on an understanding of how mulch is used in vegetable production, this review offers two lessons for stepping up mulching practises in arid, semiarid, subhumid, and temperate environments. The selection of a particular mulch material, whether organic or inorganic, based on its durability, suitability/compatibility, intended above- and below-ground impacts, and efficacy in relation to the crop type and the surrounding environment. In addition to changing the hydrothermal cycles of the soil, the plastic mulching modifies the light

The use of plastic mulch modifies the light environment surrounding the plant in addition to the hydrothermal cycles of the soil, which may have an effect on plant growth and morphogenesis..It's possible for soil water losses from evaporation to account for 50% or more of the total precipitation in places with scarce water supplies. During the crop growth period, white polyethylene mulch (non-UV) is utilised to reduce severe soil moisture loss and to promote crop establishment. This is especially true when the seedling stages are present. The highest WUEs were generated by foliar applications that reduced crop water needs by as much as 50%. Polythene mulch is more expensive, prevents vegetation germination, and maintains more soil moisture than straw mulch, despite the fact that straw mulch produced a greater economic return than polythene mulch in terms of yield and water use efficiency..In order to achieve production objectives, polyethylene mulch and trickle irrigation may be utilised in rain-fed places where water supply is severely constrained or when water and land productivity are of the utmost importance. If it is feasible economically, organic straw is the preferred mulch. Therefore, where possible, it is advisable that farmers select the mulching option for crop production in addition to the drip irrigation system. Because they decompose over time and also offer nutrients, organic mulches generate greater financial benefits.When choosing a Mulch, there are a number of factors to take into account because organic mulches can house pests like insects and rodents that can contaminate the crop or degrade its quality. We believe that white plastic mulch would be preferable in terms of, among other things, cost, durability, retaining soil moisture, enhancing soil warmth, and preventing frost.

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