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Effect of Different Mulching Materials on Onion (*Allium cepa*) Production at Lamahi, Dang, Nepal

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Abstract Winter onion production in rainfed regions is constrained by the limited availability of soil moisture. Mulching has proven to be a viable tool to conserve soil moisture and enhance yield. A field experiment was conducted to evaluate the efficiency of different mulching methods on the performance of onion (*Allium cepa* L. var. Nasik Red N 53) concerning its yield and yield attributes during the winter season (Nov–March) at Lamahi-5, Dang. The experiment was laid out following a randomized complete block design (RCBD) with three replications and seven treatments. The treatments were T1: Control, T2: Saw Dust (1 kg), T3: Straw (1 kg), T4: Banana Leaves (1 kg), T5: Neem Leaves (1 kg), T6: White Polythene (30 µ), and T7: Rice Husk (1 kg). The onion variety Nasik Red was transplanted at a spacing of 20 cm by 10 cm. Biometrical parameters like plant height, and number. of leaves, length of leaves, neck thickness, neck length, and yield-attributing characters like shoot weight, bulb weight, bulb length, bulb diameter, root length, root weight and total yield were observed. The collected data were statistically analyzed for the best mulching materials using analysis of variance (ANOVA), and the separation of means for significant effects was by least significant difference (LSD) at the 5% level of probability. Among different mulching materials, white plastic mulch was best in terms of vegetative and phenological observations like plant height (64.8 cm) and number of leaves (11) at 100 DAT, while length of leaves (32.7 cm) was found to be significant at 60 DAT. White plastic mulching at 30µ was best in terms of yield and yield attributing characteristics like bulb diameter (7 mm), bulb weight (117.5 gm), and yield per plot (27 tons/ha). In the upcoming days, it would be a better idea to use this technique to reduce weeds, conserve moisture, and improve soil health, producing more yield.
Keywords Onion (*Allium cepa*); Growth; Mulching materials; Yield

1 Introduction

Onion (*Allium cepa L.*) is one of the most important vegetable crops which occupies third rank in terms of the area and production in the global review and widely used all year round in Nepalese as an important condiment (Mishra et al., 2020). Onion (2n=2x=16), herbaceous biennial plant belonging to Alliaceae family grown foe it's edible bulb. The domestication of onion is tracked back to more than 5000 years ago from Central Asia between Turkmenistan and Afghanistan where some of relatives still grow in wild. Onion from Central Asia, supposed onion ancestor had probably migrated to Near East (Bagali et al., 2012).

Leaves arise from underground part of stem having dorsi-ventral, flattened leaf blade and flower stalks reaches height of 2.5 to 6 feet (75-180 cm), terminating in a spherical cluster of small greenish white flowers. It is commonly known as "Queen of the kitchen" due to it's highly valued flavor, aroma, unique taste and medicinal properties of its' flavor compounds (Griffiths et al., 2002). An edible portion of 100 gm raw onion bulb contains 1.1 gm protein, 9.3 gm carbohydrate, 89% water, 4.2 gm sugar, 1.7 gm fiber and 0.1 gm fat (Bjarnadottir, 2023). The Sulphur compound allyl propyl disulphide contributes to pungent aroma of onion (Randle and Lancaster, 2002). Onions has alsoplayed a vital role in preventing heart diseases and other ailments (Kim and Park, 2010).

Onion is popular over local shallot because of its high yield potential per unit area, availability of desirable cultivars for various uses, ease of propagation by seed, high domestic use (bulb and seed) and export (bulb, cut

flowers) (Teshome et al., 2015). Onions are day length sensitive; several onion types exist depending upon latitude at which they grow. Onion prefers well-drained sandy loam with high content of organic matter (Sitote and Tadese, 2018). The optimum altitude ranging from 700 and 2,200 meter above sea level (masl) and optimum growing temperature lies between 15 °C and 23 °C (Anon, 2003).

The crop requires 350-500 mm of water over the growing season (https://www.fao.org/land-water/databases) hence adequate moisture possibly through irrigation is important in the production of onions. Onion has shallow root system so it extracts very little water from depths beyond 60 cm. Thus, upper soil areas must be kept moist to stimulate root growth and provide adequate water for plant. Onion growth and development is greatly influenced by mulching and irrigation (Rahman et al., 2013). Mulching is an important technology which decreases the loss of soil water through evaporation and conserve soil moisture thus reduces the irrigation requirements, increasing root development, reducing weed attack and inducing earlier harvest of crop (Mahajan et al., 2007). The most common objective of mulching is to enhance crop growth by altering soil temperature and conserving soil moisture (Lamont, 2005).

Onion is ideally adapted to developing without extreme heat or cold or abundant rainfall in a moderate climate. Bolting is induced by low temperature during the rabi season, whereas abrupt rise in temperature causes early maturity and small sized bulbs (Khokhar, 2009). Sudden temperature rise starts in the month of March-May during which crop evapotranspiration rises (4-10 mm per day) leading to depletion of soil moisture level causing water stress to plant thereby, early maturity of bulbs and low yield (Abasi et al., 2009). To fill this soil moisture gap onion requires frequent, light irrigations (10-15) to keep the soil root zone moist; this has led to more water use even in water-scarce areas.

2 Materials and Methods

2.1 Experimental site

The research was conducted at Local farmers field at Lamahi Municipality, ward no.5, Kolahi of Dang, Nepal. The geographical location of the sites was 27.865789º N latitude and 82. 526935º E longitude with the elevation of 266 masl.

The climatic condition of Lamahi is sub-tropical with more than 80% of the total annual rainfall during the monsoon season from June to September. Since the crop is winter season crop, the winter temperature usually ranged from 12 °C to 22 °C. The soil of research field was loamy soil with pH 6.5.

2.2 Description of materials used in experiment:

2.2.1 Varietal details

Nasik Red N53 variety of onion was selected for the research experiment. It is medium red skin colored hybrid variety, flat oval in shape, sowing round the year with good yielding capacity. The bulb looks attractive and have good storing ability.

2.2.2 Seedling preparation

Nasik Red N53 variety of seeds were sown in the nursery bed to prepare the seedling of onion. Onion seed was soaked prior to sowing. A fine seed bed was prepared with adequate amount of organic matters and fertilizers. 7-10 weeks old seedlings are usually transplanted in the main field under ideal growing conditions.

2.2.3 Mulches

As inorganic mulching, white plastic with 30-micron thickness was used in the experiment. Similarly, Rice straw, rice husk, neem leaves, banana leaves and saw dust were used as organic mulches. These mulches were weighed initially and 1kg/plot were kept in the simultaneous treatment plots.

2.3 Experimental setup

2.3.1 Experimental design

A field experiment was carried out in Lamahi-5, Deukhuri, Dang. The experiment was conducted in RCBD design with 7 treatments and 3 replications. Crop geometry was 10 x 20 cm. The net area of the plot was 1.4 m^2 (1.4 x 1) and the total field area was 51.2 m^2 (12.8 x 4).

Number of plants in each plot was occupies by 1,470 seedlings, with recommended dose of fertilizers: 100:50:50 KG NPK/ha and 20 ton/ha Farm yard manure (FYM) (Urea: 73 gm, DAP: 54 gm, MOP: 19 gm, 10 kg FYM per plot).

2.3.2 Treatments details

Different organic (rice straw, rice husk, neem leaves, banana leaves, saw dust) and inorganic mulches (white polythene) were used as mulch materials whereas bare soil with no mulch was used as control plot. During treatment selection, different locally available least cost mulching materials were selected to ensure future feasibility and availability of treatments to the farmers (Table 1).

Table 1 Treatments used and their details

Treatment No.	Name of the treatments	Details
T1	Control	-
T2	Saw dust	1 kg per plot
T3	Rice straw	1 kg per plot
T4	Banana leaves	1 kg per plot
T5	Neem leaves	1 kg per plot
T6	White polythene	30 micron
T7	Rice husk	1 kg per plot

2.4 Data measurement and analysis

The data of different growth and yield attributes were collected from 10 tagged plants at different times according to the requirement for the evaluation of different treatments. Plant height was collected using measuring scale, number of leaves were counted, neck diameter, bulb diameter, bulb length was measured using vernier caliper and bulb weight was recorded using the digital weighing balance for accurate result.

2.5 Growth parameters

2.5.1 Plant height (cm)

Plant height 10 tagged plants were taken at 30, 60 and 100 days of transplanting. Height of tagged sample plants from each plot was collected. The height of the sample plants were measured from the ground level to the tip of the growing point using measuring scale (ruler). The average of plant height was worked out and expressed in centimeter.

2.5.2 Number of leaves per plant

The number of leaves per plant was counted on each sample plants at 30, 60 and 90 days of transplanting excluding senescent and emerging leaves.

2.5.3 Length of leaves

The length of green leaves of 10 sample plants from each plot was measured at 30, 60 and 90 days of transplanting. Measuring scales was used to record the length of leaves. Length of leaves were measured from the growing point of leaves formation to the tip of the leaves and expressed in centimeter.

2.5.4 Neck thickness

The thickness of the neck was recorded using measuring scales at 30 DAT and using vernier caliper at 60 and 100 days of transplanting. The average of neck thickness was calculated and expressed in centimeter.

2.5.5 Neck length
The length of the neck was measured with the help of measuring scale at 100 DAT in centimeters.

2.6. Yield parameters
2.6.1 Bulb diameter
The diameter of the bulb was measured by using vernier caliper after harvesting the bulb of the onion. 10 tagged sample plants were taken from each plot. The diameter was expressed in cm.

2.6.2 Bulb length
The length of the bulb was measured with the help of vernier caliper after harvesting of the bulb of onion for higher accuracy. Bulb length of the tagged sample plant from each plot was measured. The bulb length was expressed in cm.

2.6.3 Total yield
The total yield of each tagged sample plant was measured using digital weighing balance. Whole plant was weighted and expressed in kilogram (kg).

2.6.4 Shoot weight
The weight of the shoot was measured using weighing balance after harvesting of the onion. The shoot was removed from the bulb by cutting it 5cm above the bulb with sterilized scissor and knife. The weight of the shoot was expressed in gram (gm).

2.6.5 Bulb weight
The weight of the bulb which were cut leaving 5cm of shoots were measured using weighing balance. All the sample bulb from each plot were weighted and expressed in gram.

2.6.6 Root weight
Root weight of the onion was taken by cutting the roots from the bulb and measured by using weighing balance. The weight of root was expressed in gram.

2.7 Data analysis and techniques
2.7.1 Statistical analysis
The tagged ten sample plants were taken from each plot and observation were recorded for each parameter. The collected data were arranged in Microsoft excel. Mean value was calculated and used for statistical analysis. To analyze the treatment means and their variations statistically, collected data were subjected to analysis of variance (ANOVA) for randomized complete block design (RCBD) model.The variations among the treatment means were compared by Ducan's multiple range test at the 5% level of significance. The significance effect of treatments was judged with the help of F (Variance ratio) value. Furthermore, after the ANOVA test, a post hoc test known as Fisher's Least Significant Difference (LSD) test was conducted to separate the treatment means.

3 Results and Discussion
3.1 Effect of different mulching materials on growth parameters
3.1.1 Number of leaves
The data showed the effect of mulching on number of leaves (Table 2). It showed that there is no significant effect of mulching materials in 60 DAT. However, the effect of mulching on number of leaves was increasing significantly (P<0.01) at 100 DAT. The number of leaves at 100 DAT was highest on straw mulch followed by rice husk mulch, banana leaves mulch and the least number of leaves were recorded on sawdust mulch. More number of leaves results in high photosynthetic activities which directly influenced the yield. Higher plant height and more number of leaves in mulching may be due to suitable moisture, nutrient availability in root zone and reduced evaporation. At 100 DAT maximum number of leaves was found in straw mulch.More number of leaves results in high photosynthetic activities which directly influence the yield. Organic amendment including straw

mulch increases number of leaves, growth and yield (Islam et al., 2002). These results are similar to those obtained by Kashyap et al. (1967).

Table 2 Effect of mulching on number of leaves

Treatments	60 DAT	100 DAT
Control	4^{bc}	9^{c}
Sawdust mulch	4^{bc}	8^{c}
Straw mulch	5^{ab}	11^{a}
Banana leaves mulch	4^{abc}	11^{bc}
Neem mulch	5^{a}	9^{bc}
White polythene mulch	4^{c}	9^{c}
Rice husk mulch	4^{bc}	11^{a}
P value	0.102	0.013
LSD	NS	1.61
CV(%)	10.72	9.1
Grand mean	4.67	10.01
SEM (±)	0.13	0.30

Note: LSD= Least significant difference, SEM= Standard error of mean, CV= Coefficient of variation, NS= Non-significant, P value= Probability value

3.1.2 Plant height

The plant height varied among the treatment plots across the plant development phases (Table 3). Plant height was increased significantly (P<0.05) at 30 DAT (14.8 cm) and 100 DAT (64.8 cm). Similarly, plant height was increasing significantly (P<0.01) at 60 DAT (35.6 cm). Plant height at 30 DAT was highest on white polythene mulch followed by neem leaves mulch, banana leaves and the lowest plant height was on control. Similarly, at 60 DAT, the maximum height was found on white polythene mulch followed by neem leaves mulch, banana leaves and the lowest height was on control. Likewise, at 100 DAT maximum height was recorded on white polythene mulch followed by banana leaves, sawdust mulch and the lowest height was recorded on control. The result showed that the plant height development in mulched plots whereas stagnation of plant height on the control plot. Similar effect of highest plant in onion was depicted by Akter and Rashid (2023).

Table 3 Effect of mulching on plant height

Treatments	30 DAT	60 DAT	100 DAT
Control	10.8^{c}	20.5^{c}	48.6^{b}
Sawdust mulch	12.5^{abc}	30.9^{ab}	57.2^{ab}
Straw mulch	11.8^{bc}	30.3^{ab}	51.0^{b}
Banana leaves mulch	13.8^{ab}	33.5^{a}	61.0^{a}
Neem mulch	14.6^{a}	33.8^{a}	56.6^{ab}
White polythene mulch	14.8^{a}	35.6^{a}	64.8^{a}
Rice husk mulch	11.9^{bc}	23.6^{bc}	55.5^{ab}
P value	0.021	0.009	0.046
LSD	2.4	7.9	9.9
CV (%)	10.4	15.1	9.9
Grand mean	12.9	29.7	56.4
SEM (±)	0.40	1.50	1.60

Note: LSD= Least significant difference, SEM= Standard error of mean, CV= Coefficient of variation, P value= Probability value

3.1.3 Length of leaves

The length of leaves were found to have longer on mulched plots compared to non-mulched plots. The length of leaves was affected by mulching materials (Table 4). Length of leaves were increasing significantly (P<0.05) at 30 DAT (13.2 cm) where longest length was observed on white polythene mulch followed by neem leaves, straw mulch and the shortest length was recorded on control. Similarly, length of leaves was increasing significantly (P<0.01) at 60 DAT where the longest length was found on white polythene mulch followed by neem leaves, straw mulch and the least was recorded on control. Similarly, length of leaves were increasing significantly (P<0.01) at 60 DAT (32.7 cm) where longest length was recorded on straw mulch followed by banana leaves, white polythene and the shortest length was observed on control. Mulched treatments plots whether organic or inorganic had larger leaves number than non-mulched control plots at all stages.

Table 4 Effect of mulching on length of leaves

Treatments	30 DAT	60 DAT	100 DAT
Control	9.9^{c}	18.3^{c}	43.0^{e}
Sawdust mulch	10.7^{bc}	28.3^{ab}	46.1^{de}
Straw mulch	12.4^{ab}	30.3^{a}	55.4^{a}
Banana leaves mulch	11.6^{abc}	28.6^{ab}	55.2^{a}
Neem leaves mulch	13.1^{a}	31.2^{a}	51.4^{bc}
White polythene mulch	13.2^{a}	32.7^{a}	52.5^{ab}
Rice husk mulch	10.9^{bc}	21.4^{bc}	49.2^{cd}
P value	0.044	0.009	<0.001
LSD	2.19	7.6	3.3
CV (%)	10.6	15.7	3.7
Grand mean	11.7	27.3	50.4
SEM (±)	0.34	1.42	1.02

Note: LSD= Least significant difference, SEM= Standard error of mean, CV= Coefficient of variation, P value= Probability value

3.1.4 Neck thickness

The result showed that neck thickness was affected by mulching materials (Table 5). Neck thickness was increased significantly (P<0.001) at 30 DAT, 60 DAT and 100 DAT. The maximum neck thickness at 30 DAT was recorded on rice husk mulch followed by white polythene, neem leaves and the minimum was observed on control. Similarly, the maximum neck thickness at 60 DAT was observed on white polythene mulch followed by neem leaves, banana leaves and the minimum was found on control. Likewise, at 100 DAT the maximum neck thickness was observed on white polythene mulch followed by straw, banana leaves and the minimum neck thickness was recorded on control. This shows that the mulching material had good effect on neck thickness as compared to control.

Table 5 Effect of mulching on neck thickness

Treatments	30 DAT	60 DAT	100 DAT
Control	0.4^{b}	0.6e	1.5^{e}
Sawdust mulch	0.4^{b}	0.9^{cd}	2.2^{d}
Straw mulch	0.4^{b}	0.8^{d}	2.6^{b}
Banana leaves mulch	0.4^{b}	0.9^{c}	2.6^{bc}
Neem leaves mulch	0.5^{a}	1.1^{b}	2.2^{d}
White polythene mulch	0.5^{a}	1.2^{a}	3.03^{a}
Rice husk mulch	0.5^{a}	0.9^{d}	2.4^{cd}
P value	<0.001	<0.001	<0.001
LSD	0.03	0.06	0.3
CV (%)	3.3	3.6	6.2
Grand mean	0.4	0.9	2.4
SEM (±)	0.01	0.04	0.10

Note: LSD= Least significant difference, SEM= Standard error of mean, CV= Coefficient of variation, P value= Probability value

3.1.5 Neck length

There was significant effect of mulching materials in neck length at (P<0.01) (Table 6). White polythene mulch (9.9 cm) had longest neck length followed by banana leaves, neem leaves and shortest length was recorded on control (5.7 cm).

Table 6 Effect of mulching on neck length

Treatments	100 DAT
Control	5.7^{d}
Sawdust mulch	7.2^{cd}
Straw mulch	8.3^{bc}
Banana leaves mulch	9.3^{ab}
Neem leaves mulch	9.0^{a}
White polythene mulch	9.9^{a}
Rice husk mulch	7.2^{cd}
P value	<0.001
LSD	1.6
CV (%)	11.4
Grand mean	8.08
SEM (±)	0.34

Note: LSD= Least significant difference, SEM= Standard error of mean, CV= Coefficient of variation, P value= Probability value

3.2 Effect of mulching in yield attributing characters

3.2.1 Bulb diameter

The effect of mulching materials in bulb diameter is shown in Table 7. There was significant effect of mulching in bulb diameter of onion. Highest bulb was obtained in banana leaves(7.1 mm) followed by white polythene mulch, neem mulch, straw mulch and lowest bulb was observed in control (4.9 mm). Higher the soil temperature, more elongated the bulbs (Yamaguchi et al., 1975). So that increased soil temperature may be one reason for higher bulb diameter under these mulches.

Table 7 Effect of mulching on bulb diameter

Treatments	100 DAT
Control	4.9^{e}
Sawdust mulch	5.8^{d}
Straw mulch	6.2^{c}
Banana leaves mulch	7.1^{a}
Neem mulch	6.9^{a}
White polythene mulch	7.0^{a}
Rice husk mulch	6.6^{b}
P value	<0.001
LSD	0.3
CV (%)	2.8
Grand mean	6.4
SEM (±)	0.17

Note: LSD= Least significant difference, SEM= Standard error of mean, CV= Coefficient of variation, P value= Probability value

3.2.2 Bulb length

Table 8 shows effect of mulching on bulb length. All mulch plots had plants with greater length than the control plot. It showed there was significant effect of mulching in bulb length. Highest bulb length was obtained in white polythene mulch (5.7 cm) followed by straw mulch. Similar result was seen in banana leaf mulch. Control (4.1 cm) showed the lowest bulb length on mulching.These results are more or less similar to those obtained by Baten et al. (1995) and Chhangani (1998).

Table 8 Effect of mulching on bulb length

Treatments	100 DAT
Control	4.1[c]
Sawdust mulch	4.6[b]
Straw mulch	5.4[a]
Banana leaves mulch	5.4[a]
Neem mulch	5.3[a]
White polythene mulch	5.7[a]
Rice husk mulch	4.8[b]
P value	<0.001
LSD	0.4
CV (%)	4.6
Grand mean	5.1
SEM (±)	0.12

Note: LSD= Least significant difference, SEM= Standard error of mean, CV= Coefficient of variation, P value= Probability value

3.2.3 Shoot weight

Maximum shoot weight was seen in straw mulch of 97.7 gm (Table 9). The difference in shoot weight was significant. Banana leaves mulch 82.9 gm was obtained followed by white polythene mulch and lowest shoot weight was seen in control 36.8 gm.

Table 9 Effect of mulching on shoot weight

Treatments	100 DAT
Control	36.8[c]
Sawdust mulch	38.5[c]
Straw mulch	97.7[a]
Banana leaves mulch	82.9[ab]
Neem mulch	57.1[bc]
White polythene mulch	65.2[bc]
Rice husk mulch	56.1[bc]
P value	<0.001
LSD	30.2
CV (%)	27.3
Grand mean	62.04
SEM (±)	5.44

Note: LSD= Least significant difference, SEM= Standard error of mean, CV= Coefficient of variation, P value= Probability value

3.2.4 Bulb weight

Mulching was found to have positive impact on bulb weight of onion (Table 10). Mulching provides favorable soil microclimate along with availability of soil moisture at critical periods of plant growth. It enhances greater bulb weight. Fresh weight of 10 onion were studied as quantitative parameter. Highest bulb weight found on white polythene mulch (119.5 gm) followed by Banana leaves mulch (117.3 gm) and lowest was found on non-mulched control plots weighed (63.9 gm). Statistically on all mulch treatment weight found to be more than that of control plot. Bulb size,development and all agronomic parameters of onion were improved by organic mulch (Parsottambhai and Rawat, 2020).

3.2.5 Root length

The result showed that root length found to be longer i.e. (8.1 cm) in banana leaves mulch and found to be shorter length in control (5.6 cm) (Table 11).

3.2.6 Root weight

Statistically, root weight were found to be significant (Table 12). Root weight was found more in neem mulch (1.7 gm) and lowest root weight was found in control (0.7 gm).

Table 10 Effect of mulching on bulb weight

Treatments	100 DAT
Control	63.9[b]
Sawdust mulch	66.0[b]
Straw mulch	96.1[ab]
Banana leaves mulch	117.3[a]
Neem mulch	107.3[a]
White polythene mulch	119.5[a]
Rice husk mulch	106.2[a]
P value	0.010
LSD	32.5
CV (%)	18.9
Grand mean	96.6
SEM (±)	5.70

Note: LSD= Least significant difference, SEM= Standard error of mean, CV= Coefficient of variation, P value= Probability value

Table 11 Effect of mulching on root length

Treatments	100 DAT
Control	5.6[c]
Sawdust mulch	6.0[c]
Straw mulch	6.3[bc]
Banana leaves mulch	8.1[a]
Neem mulch	7.8[a]
White polythene mulch	7.8[a]
Rice husk mulch	7.3[ab]
P value	<0.001
LSD	1.01
CV (%)	8.07
Grand mean	7
SEM (±)	0.23

Note: LSD= Least significant difference, SEM= Standard error of mean, CV= Coefficient of variation, P value= Probability value

Table 12 Effect of mulching on root weight

Treatments	100 DAT
Control	0.7[e]
Sawdust mulch	1.0[de]
Straw mulch	1.1[bcd]
Banana leaves mulch	1.3[bc]
Neem mulch	1.7[a]
White polythene mulch	1.4[ab]
Rice husk mulch	1[cd]
P value	<0.001
LSD	0.32
CV (%)	15.4
Grand mean	1.6
SEM (±)	0.08

Note: LSD= Least significant difference, SEM= Standard error of mean, CV= Coefficient of variation, P value= Probability value

3.2.7 Total yield

The data indicates that yield (ton/ha) as influenced by mulching materials (Table 13). It showed that there was significant effect of mulching in yield of onion. Highest yield was obtained in white polythene mulch 30 μ (27 ton/ha) followed by rice husk mulch (26.9 gm), neem mulch (22.7) and lowest yield was found in non-mulch; control (13.1 ton/ha).

Table 13 Effect of mulching on total yield (ton/ha)

Treatments	100 DAT
Control	13.1[c]
Sawdust mulch	20.3[b]
Straw mulch	22.0[b]
Banana leaves mulch	22.0[b]
Neem mulch	22.7[b]
White polythene mulch	27.0[a]
Rice husk mulch	26.9[a]
P value	<0.001
LSD	3.6
CV (%)	9.2
Grand mean	22
SEM (±)	1.03

Note: LSD= Least significant difference, SEM= Standard error of mean, CV= Coefficient of variation, P value= Probability value

4 Concluding Remarks

The study showed that the either organic or inorganic mulches used both had positive impact on yield and yield attributes of onion. From the research it was concluded that mulching shows effective result in terms of number of leaves, plant height, length of leaves, neck, shoot and root length, bulb length, weight and bulb diameter and overall yield in comparison to control (no mulch). Weed control was found to be effective on mulched plots especially on white polythene mulch. So, it wise to suggest the use of mulch to increase production and productivity.

Among different mulching material white polythene mulch was found to be best in term of taken parameters. Despite having positive effect on soil moisture, temperature and yield parameters, the white polythene mulch couldn't integrate into the soil after it's span and its management was difficult due to wear and tear. Organic mulches on the other hand, easily decomposed into the soil and handling of mulch materials after the crop period was relatively easier compared to white polythene mulch. Thus, this research showed that white polythene mulch as the most suitable mulch treatment to conserve soil moisture and enhance the yield and yield attributing parameters of winter onion. In upcoming days, it would be better idea to use this technique to reduce weed, conserve moisture and improve soil health producing more yield.

Authors' contributions

DRM, AS and SKC contributed to design, data collection, interpretation and analysis of the results and drafted the manuscript. BK and BB collected data, interpreted the results and contributed to writing the manuscript. LBC analyzed the data and contributed to writing and reviewing the manuscript. All authors read and approved the final manuscript.

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Conflict of Interest Disclosure

The authors affirm that this research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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