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Influence of coloured mulches and foliar spray of nano micronutrients on growth and yield of strawberry cv. winter dawn

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Abstract
An experiment was conducted at College of Horticulture, Venkataramannagudem, Dr. Y.S.R Horticultural University, Andhra Pradesh. The present study was conducted to find out the influence of coloured mulches and foliar spray of nano micronutrients and their combination on growth and yield of Strawberry cv. Winter Dawn. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with twelve treatment combinations replicated thrice. The experiment was designed with two factors *viz.*, coloured mulches mulching materials [white (A1), black (A2) and silver (A3)] and foliar spray of nano micronutrients (Nano Zinc-1000 ppm, Nano Iron-500 ppm and Nano Boron- 200 ppm) at four levels with foliar spray of nano micronutrients each at 30 DAT (B1), 30 and 45 DAT (B2), 30, 45 and 60 DAT (B3) and 30, 45, 60 and 75 DAT (B4). The foliar spray of nano micronutrients each sprayed at 30 DAT (B1), 30 and 45 DAT (B2), 30, 45 and 60 DAT (B3) and 30, 45, 60 and 75 DAT (B4). On the basis of the statistical data, it is concluded that black colour mulch and foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT showed better results in terms of number of leaves per plant, plant height (cm), plant spread (cm2), total dry matter production (g) and number of flowers per plant and yield attributes like total number of fruits per plant, fruit weight (g), fruit volume (cc), fruit diameter (cm), yield per plant (g), yield per plot (kg) and yield per hectare (t). The use of nano micronutrients and coloured mulches are highly useful for the farming community to get higher returns in strawberry cultivation.

Keywords: Strawberry, nano micronutrients, coloured mulches

Introduction
Strawberry (*Fragaria* x *ananassa* Duch), is one of the most economically important temperate fruit known for its nutritional value. It is the most delicious, refreshing, and nutritious soft fruit originated in France. Strawberry was introduced as an exotic species in India by Antone Nicholas Duchesne in 1766. The name strawberry has been derived from the practice of straw as mulch for the effective cultivation of crops many years ago. Strawberries can be grown in a wide range of soils from heavy clay to light sand and gravel. However, it grows well in sandy loam soils with a pH of 5.5-6.5. It requires an optimum day temperature range of 22 ℃ to 23 ℃ and a night temperature of 7℃ to 13 ℃ for maximum growth and development and needs a temperature between 24 ℃ to 26 ℃ during flowering.

Strawberry production depends on management practices like mulching and the application of nutrients. The polythene mulches play a vital role in strawberry cultivation as it helps in conserving moisture, controlling weeds, regulating hydrothermal regimes and protecting the delicate fruits from direct contact with the soil (Sharma, 2009). If the appropriate wave length and colour of reflected light are chosen for the plants being grown, the growth and yield of any crop can be significantly increased.

One of the kinds of high efficiency fertilizers used to directly supply vital micronutrients to plants is nano micronutrients. The application of nano micronutrients for the nutrition of strawberry crop is one of the factors responsible for maintaining production, productivity and fruit quality. However, the usage of micronutrients comes with a price to the ecosystem, including the decarbonization of soil, alteration of edaphic biomes, contamination of ground water, and emission to the atmosphere. Foliar application of nano micronutrients exhibits increased effectiveness in terms of their delivery of nutrients to plants through fast absorption, exhibiting lower rates of loss due to fixation, leaching, or volatilization, and is one possibility to reduce ecological harm.

Material and Methods

The present experiment was conducted at College of Horticulture, Dr. YSR Horticultural University, Venkataramannagudem from November 2022 to February 2023. The tissue culture plants of Winter dawn cultivar used for the study were procured from Berries Biotech and Farms LLP, Pune. The black, white and silver colour mulches and nano micronutrients were used. The experiment was carried out in a Factorial Randomized Block Design comprising twelve treatment combinations with three replications from two factors *i.e*., coloured mulches (25µ) at three levels with white (A1), black (A2) and silver (A3) colour mulches and foliar spray of nano micronutrients (Nano Zinc @1000 ppm, Nano Iron -500 ppm and Nano Boron-200 ppm) at four levels with foliar spray of nano micronutrients each at 30 DAT (B1), foliar spray of nano micronutrients each at 30 and 45 DAT (B2), foliar spray of nano micronutrients each at 30, 45 and 60 DAT (B3), foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT (B4). The soil of the experimental field was sandy loam with a pH of 6.5 to 6.7. The soil was thoroughly ploughed and well decomposed vermicompost and arka microbial consortium was applied. The raised beds of 30 cm in height with 1m in width and a walking space of 45 cm between the beds were prepared. The raised beds were completely mulched with black, white and silver randomly before transplanting. Holes of appropriate size were made on mulching sheets for planting. Healthy and disease free tissue culture plants of Winter Dawn cultivar were planted two rows per bed in a zigzag manner with a spacing of 30 cm × 45 cm under 50% shade net conditions. The beds were irrigated with rose can to maintain optimum soil moisture conditions immediately after planting and the gap filling was done within a week after transplanting. Irrigation was provided with a micro-sprinkler system during the early stage of plant establishment for 2-3 minutes every 3-4 hours. Later Irrigation was given with a drip irrigation system provided with two laterals per bed. The entire beds were kept weed free by hand weeding at regular intervals. Fungicides like COC (Copper oxy chloride) @ 0.2% per litre were used as prophylactic drenches at initial stages to protect strawberry plants from wilt and root rot and also at later stages biocontrol agents like *Trichoderma viridae* was used to protect the plant from soil-borne microbes. Insecticides like Imidacloprid @ 0.25-0.3 ml/lt was used to control flower thrips and Chloripyriphos @ 2 ml/ lt was sprayed to control cutworms and leaf-eating caterpillar whenever noticed.

The observations on growth parameters *viz*., number of leaves per plant, plant height (cm), plant spread (cm2), total dry matter production (g) and number of flowers per plant were recorded from 45 DAT to 90 DAT at 15 days interval. The yield parameters with respect to total number of fruits per plant, fruit weight (g), fruit volume (cc), fruit diameter (cm), yield per plant (g), yield per plot (kg) and yield per hectare (t) were recorded. Five plants for each interval of the study were randomly selected and tagged in each treatment and in each replication for recording each of the destructive and non-destructive observations throughout the study *i.e*., at 45, 60, 75 and 90 DAT. The plant spread was calculated by multiplying E-W and N-S spread of the plant. The data recorded on various parameters were tabulated and were statistically analyzed by adopting factorial randomized block design (FRBD) as per the procedure outlined by Sukhatme and Amble (1985) [14]. Statistical significance was tested by 'F' value at 5% level of significance.

Results and Discussion

The coloured mulches and foliar spray of nano micronutrients has shown a significant influence on growth and yield of strawberry.

Growth Characters

The plant height was observed highest in the black colour mulch (A2) 11.36 cm, 12.89 cm, 15.69 cm and 17.80 cm, whereas the lowest plant height was recorded in white colour mulch (A1) 6.85 cm, 8.00 cm, 9.96 cm and 11.91 cm at 45, 60, 75 and 90 DAT respectively. The increase in plant height under black mulch is due to favourable environmental conditions and positive alterations of hydrothermal regime and physiochemical characteristics (Kher *et al*., 2010) [5]. Among the foliar spray of nano micronutrients and interaction, there is no significant difference observed at 45 DAT. After 45 DAT, significant differences were observed, and the plant height (10.72 cm) was found maximum in B2 (foliar spray of nano micronutrients each at 30 and 45 DAT) at 60 DAT, and 14.40 and 18.83 cm at 75 and 90 DAT respectively was recorded in foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT (B4), whereas the minimum plant height was recorded in white colour mulch (9.65, 10.60 and 11.83 cm) in B1- foliar spray of nano micronutrients each at 30 DAT. The increase in plant height by black colour mulch might be due to cell division and many biological reactions (Guo *et al*., 2011) [4]. The treatment combination black colour mulch + foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT (A2B4) recorded highest plant height (13.15, 17.29 and 21.95 cm) at 60, 75 and 90 DAT respectively, it may be due to suppressed weed infestation and improved nutrient uptake by plants to a great extent thus resulted in the increase of plant height, and the minimum plant height (7.22, 8.16 and 9.32 cm) at 60, 75 and 90 DAT respectively was recorded in A1B1- white colour mulch + foliar spray of nano micronutrients each at 30 DAT. (Table-1) Black colour mulch (A2) recorded maximum number of leaves per plant with 13.24, 15.98, 17.96 and 19.41 and the less number of leaves per plant (9.26, 12.17, 15.40 and 17.36) were noticed in white colour mulch (A1) at 45, 60, 75 and 90 DAT respectively, the increase in number of leaves per plant was possibly due to conservation of moisture and suppression of weeds (Bakshi *et al*., 2014) [2].

The foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT (B4) recorded maximum number of leaves per plant (14.33, 18.02 and 21.46), whereas the lowest number of leaves per plant (12.79, 14.64 and 16.33) were recorded in B1 (foliar spray of nano micronutrients each at 30 DAT) at 60, 75 and 90 DAT respectively, the increase in number of leaves which is due to production of chlorophyll, photosynthesis and mitochondrial respiration (Marzouk *et al*., 2019) [8]. The interaction of black coloured mulch + foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT (A2B4) recorded highest number of leaves per plant (16.38, 19.42 and 22.86) and the minimum number of leaves per plant were recorded in white colour mulch + foliar spray of nano micronutrients each at 30 DAT (A1B1) 11.26, 13.76 and 15.12 at 60, 75 and 90 DAT respectively (Table-2). The plant spread was found highest on the black colour mulch (A2) with (381.37, 488.13, 569.58 and 673.39 cm2) at 45, 60, 75 and 90 DAT respectively, this might be due to sufficient moisture

and ideal root zone temperature that provided an optimal medium for the plant (Bakshi *et al*., 2014) [2] whereas the lowest plant spread was recorded in A1 – white colour mulch (245.68, 331.76, 404.74 and 476.99 cm2) at 45, 60, 75 and 90 DAT respectively. The foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT (B4) recorded maximum plant spread (423.39, 513.93 and 687.56 cm2) and the minimum plant spread (376.03, 425.42, 479.61 cm2) was recorded in B1 (foliar spray of nano micronutrients each at 30 DAT) at 60, 75 and 90 DAT respectively. The treatment combination black colour mulch + foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT (A2B4) recorded a plant spread of 600.11 cm2 and 806.61 cm2 at 75 and 90 DAT respectively and the minimum plant spread (354.95 and 383.94 cm2) was recorded in A1B1 (black colour mulch + foliar spray of nano micronutrients each at 30 DAT) (Table- 3).

Black colour mulch (A2) has shown significantly maximum number of flowers per plant (4.96, 7.48, 12.32 and 17.73) at 45, 60, 75 and 90 DAT respectively, this is due to benefit of reduced water loss, reduced soil erosion and weeds, which in turn increased vegetative development, thus positively reflected on flowering (Kour and Singh, 2009) and the minimum number of flowers per plant (3.43, 5.46, 9.45 and 12.18) were recorded in white colour mulch (A1). Among the foliar spray of nano micronutrients, the number of flowers per plant was found highest (6.62) in foliar spray of nano micronutrients each at 30, 45 and 60 DAT (B3) at 60 DAT and 12.78 and 21.46 flowers per plant at 75 and 90 DAT in foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT (B4) and the lowest number of flowers per plant (5.72, 7.90 and 9.89) in B1 (foliar spray of nano micronutrients each at 30 DAT), the increase in number of flowers might be due to the effect of boron in pollen germination and regulating metabolism that is involved in the translocation of carbohydrates, cell wall development and RNA synthesis (Ram and Bose, 2000) [10]. Among the interaction, the number of flowers per plant (7.79) was found maximum at 60 DAT in black colour mulch + foliar spray of nano micronutrients each at 30, 45 and 60 DAT (A2B3) and 14.87 and 26.28 flowers per plant at 75 and 90 DAT was recorded maximum in black colour mulch + foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT (A2B4) and the minimum number of flowers per plant (4.87,6.88 and 8.68) were recorded in A1B1 (white colour mulch + foliar spray of nano micronutrients each at 30, DAT) (Table- 4).

Total dry matter production was found highest in black colour mulch (5.66, 6.99, 9.20 and 11.47 g) and lowest in white colour mulch (4.45, 5.66, 8.00 and 9.56) at 45, 60, 75 and 90 DAT respectively. Among the foliar spray of nano micronutrients, the total dry matter production of 6.72 g was recorded highest in foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT (B4) and foliar spray of nano micronutrients each at 30, 45 and 60 DAT (B3) at 60 DAT. Total dry matter production of 9.65 g and 13.49g at 75 and 90 DAT was found highest in B4 (foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT) and the minimum total dry matter production (5.74, 7.21 and 8.15 g) was recorded in B1 (foliar spray of nano micronutrients each at 30 DAT). The treatment combination black colour mulch + foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT (A2B4) recorded highest with 7.25 g, 10.24 g and 15.65 g and the minimum (5.00, 6.48 and 7.92 g) was recorded in A1B1 (black colour mulch + foliar spray of nano micronutrients each at 30, DAT) at 60, 75 and 90 DAT respectively (Table-5).

Yield Characters

The data pertaining to yield mentioned in Table-6 and Fig-1 was significantly influenced by coloured mulches, foliar spray of nano micronutrients and their interaction. Black colour mulch (A2) has recorded significantly superior yield in terms of total number of fruits per plant (15.92), fruit weight (11.57 g), yield per plant (186.48 g) and yield per hectare (9.31 t/ha). The increase in yield of the fruits under black colour mulch might be due to the enhanced effect of mulch on water conservation, photosynthetic activity and metabolite translocation, reducing the competition of nutrients to the plants by providing a modified soil hydrothermal conditions under mulch, that ultimately accelerated the rate of vegetative growth and yield (Pandey *et al*., 2016) [9]. The minimum total number of fruits (11.90), fruit weight (9.25), yield per plant (110.95) and yield per hectare (5.54 t/ha) was recorded in white colour mulch (A1).

The foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT (B4) recorded significantly highest with respect to total number of fruits per plant (16.14), fruit weight (12.34 g), yield per plant (202.29 g) and yield per hectare (10.11 t/ha). The increase in yield due to the foliar spray of nano micronutrients that consistes of boron which helps in pollination and pollen tube germination (Lee and Kim, 1991), zinc in growth-promoting substances (Shivanandam *et al*., 2007) [13] and iron in electron transport chain reactions all of which contribute to more photosynthetic activity and higher production of sugars (Sathiyamurthy *et al*., 2017) [13]. Increase in the size of fruits might be due to the multiplication and enlargement of cells and a higher accumulation of food materials like sugar and water in expanded cells (Dutta and Banik, 2007). The minimum number of fruits per plant (12.14), fruit weight (9.33 g), yield per plant (114.09 g) and yield per hectare (5.69 t/ha) was recorded in B1 (foliar spray of nano micronutrients each at 30 DAT).

The interaction of coloured mulches and foliar spray of nano micronutrients was found significantly superior on yield parameters with respect to total number of fruits per plant (17.88), fruit weight (13.42 g), yield per plant (240.08 g) and yield per hectare (12.00 t/ha) in A2B4 (black colour mulch + foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT). The minimum number of fruits per plant (10.76), fruit weight (8.23 g), yield per plant (88.55 g) and yield per hectare (4.42 t/ha) was recorded in A1B1 (white colour mulch + foliar spray of nano micronutrients each at 30 DAT).

Table 1: Influence of coloured mulches and foliar spray of nano micronutrients on plant height (cm) of strawberry cv. Winter Dawn

Coloured) mulches (A)	Nano micronutrients (B)																			
	45 Days after transplanting					60 Days after trans_plantin					75 Days after transplantin					90 Days after transplanting				
	Bi	B2	B3	B4	Mean A	Bi.	B2	B3	B4	Mean A	B).	B2	B3	B4	Mean A	B).	B2	B3	B4	Mean A
Ai	6 84	6.81	6.87	6.87	6.85	7.22	8.29	8.26	8.21	8.00	8.16	9.14	11.29	11.23	9.96	9.32	10.22	12.45	15.66	11.91
A2	11.38	11.38	11.33	11.35	11.36	12.27	13.02	13.14	13.15	12.89	13.39	14.86	17.21	17.29	15.69	14.62	15.98	18.65	21.95	17.80
A3	8.84	8.85	8.89	8.87	8.86	9.47	10.86	9.81	9.65	9.95	10.26	11.82	14.55	14.67	12.83	11.54	13.01	16.17	18.89	14.90
Mean B	9.02	9.01	9.03	9.03		9.65	10.72	10.40	10.33		10.60	11.94	14.35	14.40		11.83	13.07	15.76	18.83	
Factors	SE m ±		CD at 5%			SE m ±		CD at 5%			SE m ±		CD at 5%			SE m ±		CD at 5%		
A	0.02		0.07			0.03		0.09			0.04		0.12			0.05		0.15		
B	0.03		NS			0.03		0.10			0.05		0.13			0.06		0.17		
A X B	0.05		NS			0.06		0.17			0.08		0.23			0.10		0.30		

Table 2: Influence of coloured mulches and foliar spray of nano micronutrients on number of leaves per plant of strawberry cv. Winter Dawn

Coloured mulches	45 Days after transplanting					60 Days after transplanting					Nano micronutrients (B) 75 Days after transplanting					90 Days after transplanting				
(A)	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A
A1	9.28	9.23	9.25	9.27	9.26	11.26	12.48	12.49	12.46	12.17	13.76	14.22	16.78	16.83	15.40	15.12	16.09	18.32	19.89	17.36
A2	13.21	13.23	13.26	13.25	13.24	14.88	16.31	16.33	16.38	15.98	15.67	17.41	19.33	19.42	17.96	17.26	18.12	19.38	22.86	19.41
A3	11.15	11.17	11.15	11.18	11.16	12.24	13.60	14.10	14.15	13.52	14.48	16.60	17.79	17.80	16.67	16.62	17.76	19.95	21.63	18.99
Mean B	11.21	11.21	11.22	11.23		12.79	14.13	14.31	14.33		14.64	16.08	17.97	18.02		16.33	17.32	19.22	21.46	
Factors	SE m ±		CD at 5%			SE m ±		CD at 5%			SE m ±		CD at 5%			SE m ±		CD at 5%		
A	0.02		0.07			0.02		0.07			0.02		0.07			0.03		0.09		
B	0.03		NS			0.03		0.08			0.03		0.08			0.05		0.10		
A X B	0.05		NS			0.04		0.14			0.05		0.14			0.06		0.18		

Note: A: Coloured mulches: A1: White, A2: Black, A3: Silver.

B: Nano Zn @ 1000ppm, Nano Fe @ 500 ppm, Nano B @ 250 ppm, B1: Foliar spray of nano micronutrients each at 30 DAT, B2: Foliar spray of nano micronutrients each at 30 and

45 DAT, B3: Foliar spray of nano micronutrients each at 30, 45 and 60 DAT, B4: Foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT.

Table 3: Influence of coloured mulches and foliar spray of nano microntrients on plant spread (cm2) of strawberry cv. Winter Dawn

Coloured mulches	45 Days after transplanting					60 Days after transplanting					Nano micronutrients (B) 75 Days after transplanting					90 Days after transplanting				
(A)	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A
A1	245.18	245.71	246.00	245.81	245.68	296.27	343.31	343.78	343.68	331.76	354.95	394.02	433.65	436.33	404.74	383.94	439.56	516.68	567.76	476.99
A2	381.17	381.11	381.26	381.94	381.37	450.87	499.71	500.41	501.52	488.13	522.95	559.03	596.22	600.11	569.58	588.43	633.14	665.39	806.61	673.39
A3	305.08	305.78	306.23	306.19	305.82	380.94	423.31	424.12	424.96	413.33	398.37	444.87	507.07	505.35	463.92	466.45	508.05	563.35	688.30	556.54
Mean B	310.48	310.87	311.16	311.31		376.03	422.11	422.77	423.39		425.42	465.97	512.31	513.93		479.61	526.92	581.81	687.56	
Factors	SE m ±		CD at 5%			SE m ±		CD at 5%			SE m ±		CD at 5%			SE m ±		CD at 5%		
A	0.77		2.28			0.92		2.73			1.28		3.77			1.55		4.59		
B	0.89		NS			1.07		3.15			1.47		4.35			1.79		5.30		
A X B	1.54		NS			1.85		NS			2.55		7.53			3.11		9.18		

Table 4: Influence of coloured mulches and foliar spray of nano micronutrients on number of flowers per plant of strawberry cv. Winter Dawn

Coloured mulches	45 Days after transplanting					60 Days after transplanting					Nano micronutrients (B) 75 Days after transplanting					90 Days after transplanting				
(A)	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A
A1	3.33	3.53	3.43	3.44	3.43	4.87	5.67	5.64	5.67	5.46	6.88	8.63	11.12	11.15	9.45	8.68	9.44	13.83	16.78	12.18
A2	4.93	4.95	4.97	4.97	4.96	6.63	7.78	7.79	7.73	7.48	9.23	10.34	14.82	14.87	12.32	11.21	13.63	19.79	26.28	17.73
A3	4.12	4.13	4.15	4.15	4.14	5.66	6.38	6.44	6.42	6.23	7.58	9.65	12.22	12.31	10.44	9.78	12.64	17.87	21.33	15.41
Mean B	4.13	4.20	4.18	4.19		5.72	6.61	6.62	6.61		7.90	9.54	12.72	12.78		9.89	11.90	17.16	21.46	
Factors	SE m ±		CD at 5%			SE m ±		CD at 5%			SE m ±		CD at 5%			SE m ±		CD at 5%		
A	0.01		0.03			0.01		0.04			0.03		0.10			0.07		0.21		
B	0.01		NS			0.02		0.04			0.04		0.12			0.08		0.24		
A X B	0.02		NS			0.03		0.07			0.07		0.20			0.14		0.42		

Note: A: Coloured mulches: A1: White, A2: Black, A3: Silver.

B: Nano Zn @ 1000ppm, Nano Fe @ 500 ppm, Nano B @ 250 ppm, B1: Foliar spray of nano micronutrients each at 30 DAT, B2: Foliar spray of nano micronutrients each at 30 and

45 DAT, B3: Foliar spray of nano micronutrients each at 30, 45 and 60 DAT, B4: Foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT.

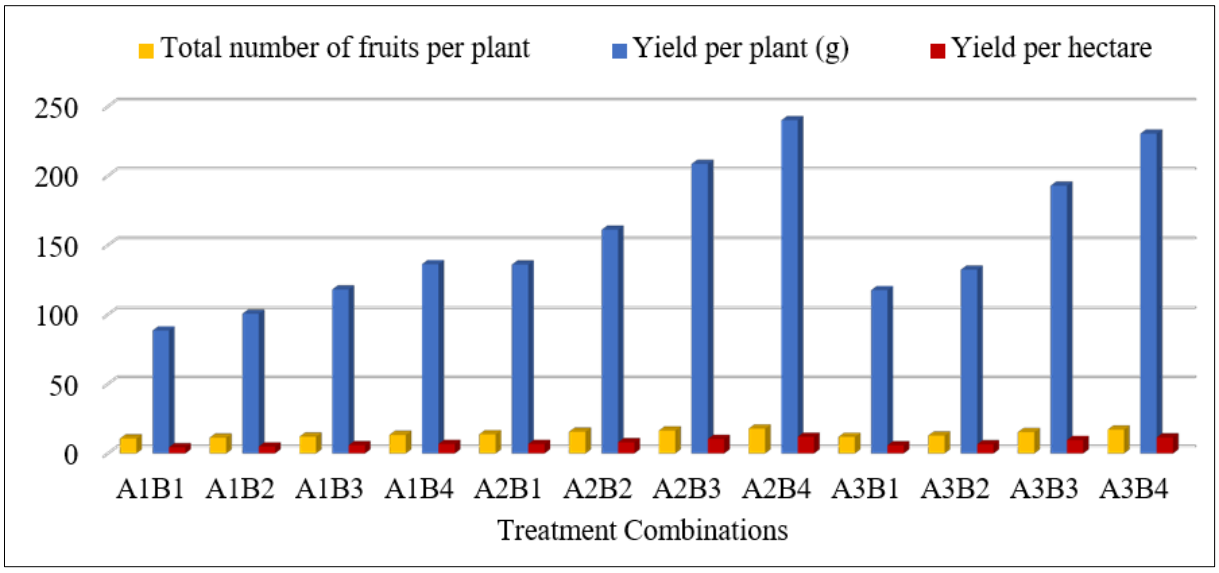
Table 3: Influence of coloured mulches and foliar spray of nano microntrients on plant spread (cm2) of strawberry cv. Winter Dawn

Coloured mulches	45 Days after transplanting					60 Days after transplanting					Nano micronutrients (B) 75 Days after transplanting					90 Days after transplanting				
(A)	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A
A1	4.43	4.45	4.48	4.44	4.45	5.00	5.82	5.90	5.92	5.66	6.48	7.63	8.88	9.02	8.00	7.92	8.86	9.98	11.48	9.56
A2	5.65	5.67	5.64	5.68	5.66	6.30	7.18	7.23	7.25	6.99	7.84	8.51	10.21	10.24	9.20	8.53	9.16	12.54	15.65	11.47
A3	4.94	4.98	4.99	4.94	4.96	5.91	6.97	7.03	7.00	6.73	7.30	8.13	9.67	9.70	8.70	8.01	9.66	11.34	13.33	10.59
Mean B	5.01	5.03	5.03	5.02		5.74	6.66	6.72	6.72		7.21	8.09	9.59	9.65		8.15	9.23	11.29	13.49	
Factors	SE m ±		CD at 5%			SE m ±		CD at 5%			SE m ±		CD at 5%			SE m ±		CD at 5%		
A	0.01		0.02			0.01		0.03			0.02		0.05			0.03		0.09		
B	0.01		NS			0.01		0.03			0.02		0.06			0.04		0.11		
A X B	0.01		NS			0.02		0.06			0.03		0.10			0.06		0.18		

Table 6: Influence of coloured mulches and foliar spray of nano micronutrients on total number of fruits per plant, fruit weight (g), yield per plant (g) and yield per hectare (t) of strawberry cv. Winter Dawn

Coloured mulches	Total number of fruits per plant					Fruit weight (g)					Nano micronutrients (B) Yield per plant (g)					Yield per hectare (t)				
(A)	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A	B1	B2	B3	B4	Mean A
A1	10.76	11.42	12.12	13.33	11.90	8.23	8.82	9.75	10.23	9.25	88.55	100.72	118.17	136.36	110.95	4.42	5.02	5.90	6.82	5.54
A2	13.76	15.62	16.45	17.88	15.92	9.88	10.32	12.67	13.42	11.57	136.08	161.20	208.58	240.08	186.48	6.80	8.05	10.42	12.00	9.31
A3	11.92	12.87	15.35	17.21	14.33	9.87	10.29	12.57	13.39	11.53	117.64	132.43	192.95	230.44	168.36	5.87	6.62	9.64	11.52	8.41
Mean B	12.14	13.30	14.64	16.14		9.33	9.81	11.66	12.34		114.09	131.45	173.23	202.29		5.69	6.56	8.65	10.11	
Factors	SE m ±		CD at 5%			SE m ±		CD at 5%			SE m ±		CD at 5%			SE m ±		CD at 5%		
A	0.03		0.09			0.02		0.07			0.68		2.04			0.03		0.10		
B	0.04		0.11			0.03		0.09			0.78		2.30			0.04		0.12		
A X B	0.06		0.19			0.05		0.14			1.35		4.05				0.07	0.20		

Note: A: Coloured mulches: A1: White, A2: Black, A3: Silver.
B: Nano Zn @ 1000ppm, Nano Fe @ 500 ppm, Nano B @ 250 ppm, B1: Foliar spray of nano micronutrients each at 30 DAT, B2: Foliar spray of nano micronutrients each at 30 and
45 DAT, B3: Foliar spray of nano micronutrients each at 30, 45 and 60 DAT, B4: Foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT.



Note: A: Coloured mulches: A1: White, A2: Black, A3: Silver.
B: Nano Zn @ 1000ppm, Nano Fe @ 500 ppm, Nano B @ 250 ppm, B1: Foliar spray of nano micronutrients each at 30 DAT, B2: Foliar spray of nano micronutrients each at 30 and 45 DAT, B3: Foliar spray of nano micronutrients each at 30, 45 and 60 DAT, B4: Foliar spray of nano micronutrients each at 30, 45, 60 and 75 DAT.

Fig 1: Influence of coloured mulches and foliar spray of nano micronutrients on total number of fruits per plant, yield per plant (g), yield per hectare (t)

Conclusion

Among the coloured mulches used, black colour mulch performed best interms of growth and yield when compared to white and silver colour mulches. The foliar spray of nano micronutrients (Nano zinc-1000ppm, Nano Iron- 500 ppm, Nano Boron- 200ppm) each sprayed at 30, 45, 60 and 75 days after transplanting resulted in maximum growth and yield of the strawberry. The treatment interaction of black colour mulch and foliar spray of nano micronutrients each sprayed at 30, 45, 60 and 75 DAT has resulted in maximum growth and yield of the plant when compared to the other combinations. Thus, the use of black colour mulch and foliar spray of nano micronutrients each sprayed at 30, 45, 60 and 75 DAT is a feasible and economical way for farmers in cultivation of strawberry to fetch good yield and returns.

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References

1. Ali RAM, Radwan EA. Effect of organic and synthetic mulches of some fresh strawberry cultivars. Journal of Agricultural and Enviromental Science. 2008;7(3):167-200.
2. Bakshi P, Bhat DJ, Wali VK, Sharma A, Iqbal M. Growth, Yield and quality of strawberry (*Fragaria ananassa* Duch.) cv. Chandler as influenced by various mulching materials. African Journal of Agriculture Research. 2014;9(7):701-706.
3. Dutta P, Banik AK. Effect of foliar feeding of nutrients and plant growth regulators on physico-chemical quality of Sardar guava grown in red and lateritic tract of West Bengal. Acta Horticulturae. 2007;735:407-411.
4. Guo B, Abbasi BH, Zeb A, Xu LL, Wei YH. Thidiazuron: A multi-dimensional plant growth regulator. African Journal of Biotechnology. 2011;10(45):8984-9000.
5. Kher R, Baba JA, Bakshi P. Influence of planting time and mulching material on growth and fruit yield of strawberry cv. Chandler. Indian Journal of Horticulture. 2010;64(4):441- 444.
6. Kour R, Singh S. Impact of mulching on growth, yield and quality of strawberry (*Fragaria ananassa* Duch.). The Asian Journal of Horticulture. 2009;4(1):63-64.
7. Lee SS, Kim KR. Studies on the internal browning of apple fruits, caused by excessive boron application and mineral and some organic contents of fruit according to excessive B application. Journal of Korean Society of Horticultural Science. 1991;32(2):184-90.
8. Marzouk NM, Abd-Alrahman HA, EL-Tanahy AMM, Mahmoud SH. Impact of foliar spraying of nano micronutrient fertilizers on the growth, yield, physical quality, and nutritional value of two snap bean cultivars in sandy soils. Bulletin of the National Research Centre. 2019;43(1):1-9.
9. Pandey S, Tewari GS, Singh J, Deepak R, Gopal K. Efficacy of mulches on soil modifications, growth, production and quality of strawberry (*Fragaria x ananassa* Duch.). International journal of science and nature. 2016;7(4):813-820.
10. Ram RA, Bose TK. Effect of foliar application of magnesium and micronutrients on growth, yield and fruit quality of mandarin orange. Indian Journal of Horticulture. 2000;57(3):215-220.
11. Sathiyamurthy VA, Shanmugasundaram T, Rajasree V, Arumugam T. Effect of foliar application of micronutrients on growth, yield and economics of tomato (*Lycopersicon esculentum* Mill.). Madras Agricultural Journal. 2017;104(4-6):188-93.
12. Sharma VK. Effect of mulching and row spacing on growth and yield of strawberry. Indian Journal of Horticulture. 2009;66(2):271-273.
13. Shivanandam VN, Pradeep SL, Rajanna KM. Effect of zinc sulphate on growth and yield of mango varieties and hybrids. Journal of Soils and Crops. 2007;17(2):225-229.
14. Sukhatme PV, Amble VN. Statistical methods for agricultural workers. ICAR, New Delhi; c1985. p. 187-202.