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EFFECT OF POLYTHENE MULCH ON WEED MANAGEMENT AND YIELD OF CHILLI

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Abstract

The field experiment was conducted during *Kharif* seasons of 2021 and 2022 in the research field of Regional Spices Research Centre, Bangladesh Agricultural research Institute (BARI), Gazipur to evaluate the performances of different polythene mulches on weed management efficiency and fruit yield of chilli var. BARI Morich-2. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The treatments comprised five polythene mulches (30µ thickness), viz. black polythene mulch, transparent polythene mulch, silver on black polythene mulch, blue polythene mulch and unweeded. The two years' pooled results revealed that almost all the yield and yield contributing parameters were significantly influenced by polythene mulches to produce fruit yield of chilli. The maximum weed control index (94.61%), weed control efficiency (89.2%), fresh red fruit yield (20.3 t ha^{-1}), dry fruit yield (7.8 t ha^{-1}) and seed yield (482.3 kg ha^{-1}) were recorded from silver on black polythene mulch, whereas the minimum fresh red fruit yield (5.6 t ha^{-1}), dry fruit yield (2.3 t ha^{-1}) and seed yield (118.7 kg ha^{-1}) were found in unweeded plot. It may be suggested that silver on black polythene mulch could be effective in weed control and fruit yield as well as seed yield of chilli.

Keywords: Chilli, polythene mulch, weed management, fruit yield, seed yield.

Introduction

Chilli (*Capsicum annuum* L.), a member of the Solanaceae family, is popularly known as 'morich' in Bangladesh. It is the second most important commercial spices crop in Bangladesh in terms of production and its diversified uses. In 2021-2022, Bangladesh produced 6.25 lakh tons chilli (*kharif chilli*: 1.29 lakh tons and winter chilli: 4.96 lakh tons) with an average yield of 6.35 t ha^{-1} (*kharif chilli*: 6.33 t ha^{-1} and winter chilli: 6.36 t ha^{-1}) covering 0.98 lakh hectares (*kharif*: 0.20 ha and winter: 0.78 ha) of land (Anon., 2023). Chilli is often consumed as fresh (green), dry and processed products (powder) for its aromatic odor, flavor, coloring substance, medicinal and seasoning properties being rich in proteins, lipids, carbohydrates, fibers, minerals (Ca, P, Fe, K), vitamins (A, D, E, C, K, P, B_2 and B_{12}) and anti-oxidant (Sathiyamurthy *et al.*, 2017). The crops are cultivated both in *rabi* (winter) season for dry chilli and *Kharif* for green chilli in Bangladesh.

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Among the yield limiting factors, weeds pose a significant challenge reducing 45-70% fruit yield by competing with plants for resources (plant nutrients, soil moisture, active sunlight and land) and also acting as co-host and vectors of insects, mites and diseases (Kumar *et al*., 2021). Sustainable weed management is crucial particularly during the initial stage of chilli plants because weeds germinated fast and grow rapidly (Wickramarathne *et al.*, 2021). There are several weed management practices, namely manually, mechanical, herbicide and mulching. Hand weeding is a famous traditional weed management practices which is the most time consuming, accounts 30-40% of production (Kharwal and Yadav, 2023). Application of herbicide is a better supplement to conventional method considering weed emergence pattern, application time and crop growth stage. Mulching is covering materials on the surface of soil to cost effective and eco-friendly technology alternative to conventional and herbicides, which keeps the field in weed free, conserve soil moisture, regulate soil temperature, reduce salinity, control soil erosion, moves soil microbes and improve soil health with minimizing nutrient losses (Iqbal *et al*., 2020). Polythene and plastic (polyvinyl chloride) mulches are the most popular inorganic mulch, altering the soil microclimates (increasing soil temperature & air and reducing evaporation), impacting soil ecosystems (prevent soil compaction, increasing nutrient and dioxide concentration) and microbial community (ensure convenient environment for beneficial microbes and suppressing soil borne pathogens) which significantly influence on growth (especially root growth) and quality fruit yield of chilli, reducing leaching loss of plant nutrients and reducing the degree of weed infestation (Kefelegn and Desta, 2021; Wickramarathne *et al.*, 2021). There are different kinds and colors of polythene mulch such as white, black, white on black, silver on black, grey, infrared transmitted brown (IRT-brown), IRT-green etc. used in agriculture (Ibarra-Jiménez *et al*., 2008). Black polythene mulch does not allow to pass photosynthetic active radiations (PAR) which inhibits emergence and growth of weeds beneath the mulches and helps to control 100% weeds (Iqbal *et al*., 2020). Though black polythene mulch is applied generally in worldwide which had adverse effect on environment. To prevent this problem silver on black polythene mulch is used as alternatives (Wickramarathne *et al.*, 2021). Therefore, the present study was conducted to evaluate the performance of polythene mulch in managing weeds and satisfactory fruit and seed yield of chilli.

Materials and Methods

The field experiment was conducted during *Kharif* seasons of 2021 and 2022 at the research field of Regional Spices Research Center, Bangladesh Agricultural Research Institute (BARI), Gazipur, situated at $23^{0}59^{/}$ North Latitude and $90^{0}24^{/}$ East Longitude with an altitude of 8.4 m above the mean sea level. The experimental site featured belonging to Chhiata Soil series categorized as Grey Terrace Soil within Inceptisol in Taxonomy under the AEZ-28 (Madhupur Tract) was described by Brammer (1971). The collected soil samples (0-30 cm depth) of the experimental field were analyzed in the Soil Science Laboratory, BARI, Gazipur using standard methods (Table 1). The experiment was laid out in a Randomized Complete Block Design (RCBD) with five treatments. The treatments were: T_1 = Transparent polythene mulch, T_2 = Black polythene mulch, T_3 = Silver on black polythene mulch, T_4 = Blue polythene mulch and T_5 = Unweeded (no mulch as Control), replicated three times. The thickness of used polythene mulch being 30µ. The seeds of chilli (var. BARI Morich-2) were sown on 25 January 2021 and 28 January 2022 for the first and second year, respectively in 3 m x 1 m sized seedbed with a line-to-line distance of 10 cm prior to raise seedling. Before sowing, the seeds were treated with Autostin (carbendazim) @ 2 g kg^{-1} for preventing primary seed borne as well as soil borne diseases. The seedlings (40 days old) were transplanted in 3 m x 3 m sized main plots maintaining 50 cm x 50 cm spacing on 7 March 2021 and 10 March 2022, respectively. During transplanting, the root zone of seedlings was dipped in Autostin @ 0.2% solution for controlling foot and root disease of chilli. The recommended dose chemical fertilizer on soil test basis, 120-60-100-30-1.5-1.5 kg ha^{-1} of N- P -K -S -Zn- B with 5 t ha^{-1} of cowdung (FRG, 2018). The total amount of well decomposed cowdung, 1/4th of urea for N, TSP for P, 1/3rd of MoP for K, gypsum for S, $ZnSO_4$ for Zn and boric acid for B were applied in broadcast and incorporated to the soil during final land preparation. Top-dressings were done using ring method of N and K fertilizer at 40, 65 and 90 days after transplanting (DAT) of chilli in both the years with equal amount. The polythene mulch was cut into pieces of 3.5 m long to cover the entire plot and anchored 25 cm in to the soil. A scissorwas used to cut the holes as per inter and intra row spacing where chilli seedlings were then transplanted. Irrigation was done immediately and equal amount after transplanting by watering can with fine meshed nozzle. Guard rows were established around the entire plot for insect reflecting and also for gap filling purpose. While final land preparation Ecofuran 5G (carbofuran) @ 10 kg ha^{-1} was applied in broadcast for controlling soil and foliar-feeding insects such as, stem borer, top shoot borer, wireworms, boll worm, weevil, white grubs and nematode. Throughout the entire cropping season, spraying insecticide Ripcord (Cypermethrin), miticide Vertimec (Abamectin) and fungicide Indofil M-45 (Mancozeb) along with two irrigations were done for proper growth and development of the crop. The well ripened chillies from selected plants were collected four times by hand between 15 May to 01 November in both the years. Before sundried the harvested chillies were cured in a shady place for 3 days. When dried enough, then the chillies were kept in double layer polythene bag into a jute bag for storing. To collect seeds, the dried fruits keeping inside jute bags were beaten by bamboo sticks. Then, the seeds were separated and sieved using BSS 8 x 8 sieves and seeds were dried well to maintain seed moisture less than 10% and weighed Seed yield was calculated from the plot yield. Soil temperature was monitored using a gardener's soil thermometer (Brannan brand) at 5 to 10 cm beneath the soil in the experimental plot twice in every month. Soil moisture content was determined using digital soil moisture meter (Field Scout, TDR 300, Spectrum technology, Inc, USA) at 10-30 cm beneath the soil in every 10 days intervals.

Weed density and weed biomass per square meter

Immediate after final harvesting the crops, the weeds were collected from 1m^2 area at the center place of the plot and dried to obtained dry biomass (kg ha^{-1}). The uprooted weeds were air-dried in the laboratory and finally oven-dried for 72 hours at 70^{0}C to estimate dry biomass production. The dry biomass of weeds was calculated by the following formula (Yadav *et al.*, 2015):

BM = {(DY X 10000)}/1000

Where,

BM = Dry biomass (kg ha^{-1})

DY = Total dry yield of weeds per square meter (g)

Weed control index (WCI) was estimated by following formula (Das *et al*., 2016):

WCI = [{Dry biomass of weeds in control plot (g m^{-2}) – Dry biomass of weed in treated plot (g m^{-2})}/ Dry biomass of weed in control plot (g m^{-2})] X 100

Weed control efficiency (WCE) was estimated by following formula (Das *et al*., 2016):

WCE = [{Weed density in control plot (number m^{-2}) – Weed density in treated plot (number m^{-2})}/ Weed density in control plot (number m^{-2})] X 100

The recorded data on different parameters were statistically analyzed by using R version 3.5.0 software to find out the significant variation results from different treatments. The difference between treatments means were judged by Least Significant Difference (LSD) test at 5% level of significance.

Table 1. Average physical and chemical properties of initial soil of the experimental field

Soil characteristics	Analytical value	Analytical method
Soil Textual class	Silty clay loam	Hydrometer method
Bulk density (g cm^{-3})	1.41	Core sampling method
Particle density (g cm^{-3})	2.66	Pycnometer method
Soil pH	5.98	Soil: water=1:2.5
Total N (%)	0.08	Modified Kjeldhal Method
Organic C (%)	0.9	Wet oxidation method
Available P (ppm)	7.05	Bray and Kurtz method
Exchangeable K (meq100g^{-1}soil)	0.07	N NH_4OAc extraction method
CEC (meq 100g^{-1} soil)	9.31	N NH_4OAc extraction method
Available B (ppm)	0.11	Calcium chloride extraction method
Available Zn (ppm)	0.36	DTPA Extraction method
Available Cu (ppm)	0.18	DTPA Extraction method
Available Mn (ppm)	0.61	DTPA Extraction method
Available S (ppm)	6.0	Calcium dihydrogen phosphate extraction method

Weather parameters

Throughout the experimental periods, monthly average maximum and minimum temperature, relative humidity and rainfall data were diligently recorded and depicted in Figure 1a and 1b, respectively. The monthly average of maximum temperature range (25.02^{0}C to 45.18^{0}C in the year of 2021 and 24.77^{0}C to 34.73^{0}C in the year of 2022) and minimum temperature (13.36^{0}C to 26.96^{0}C and 14.12^{0}C to 31.29^{0}C). The total annual rainfall (1626 mm and 1557 mm) and humidity range (71.2 to 89.16% and 77.73 to 88.17%) both the year of 2021 and 2022, respectively. Yearly average soil temperature and soil moisture content were categorized through treatment wise were also meticulously documented and illustrated in Figure 2. The yearly soil temperature and soil moisture range varied (17.5^{0}C to 32.1^{0}C and 18.1^{0}C to 33.3^{0}C) and (17.5 to 30.5% and 18.5 to 33.8%) at different mulching treatments, both the year of 2021 and 2022, respectively.

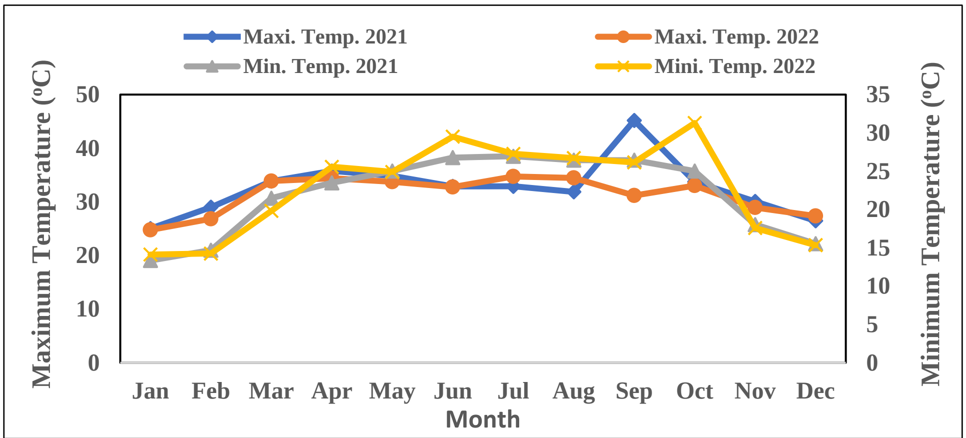

Fig. 1a. Monthly average maximum and minimum temperature of the BARI experimental farm during 2021 and 2022.

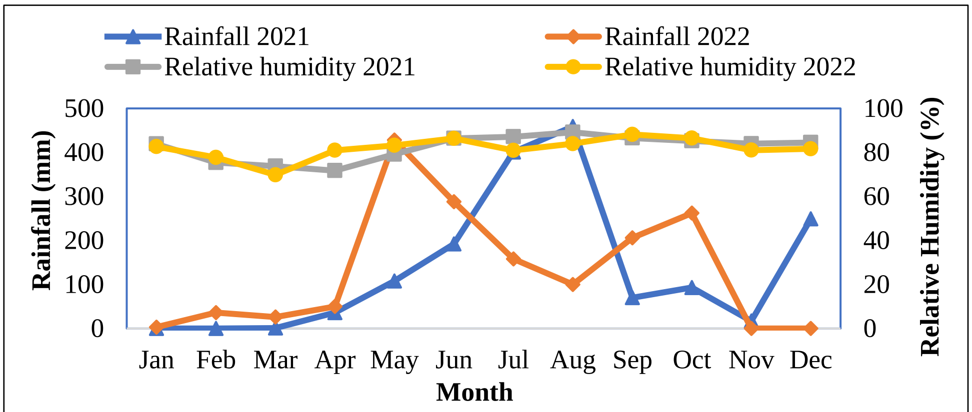

Fig. 1b. Monthly rainfall with monthly average relative humidity of the BARI experimental farm during 2021 and 2022.

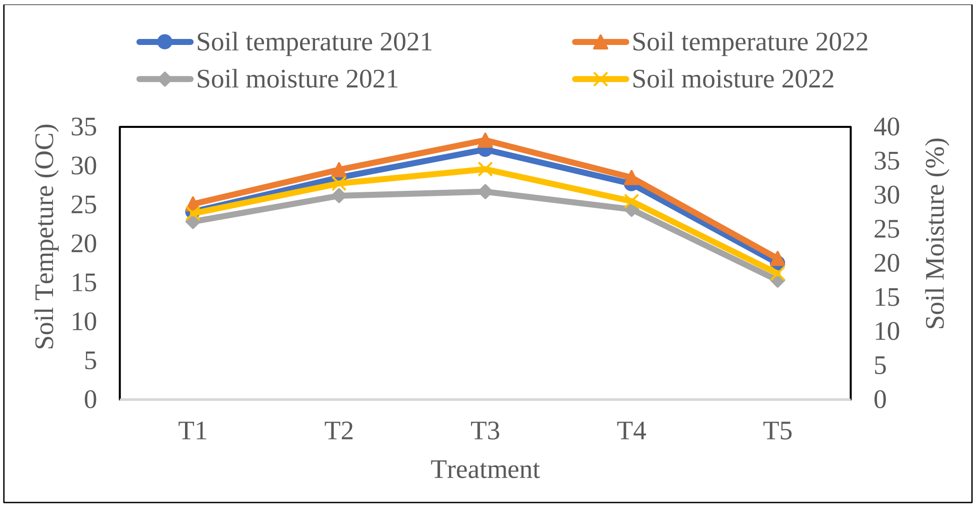

Fig. 2. Yearly average Soil temperature and Soil moisture of different treatment during 2021 and 2022.

Results and Discussion

The experimental field exhibited varying densities of broadleaved, grass and sedge weeds as summarized in Table 2. Notably, *Cyperus rotundus* (60%) *Cynodon dactylon* (11%), *Eleusine indica* (10%) and *Echinochloa crussgalli* (6%) emerged as the predominant weed genotypes within the field. When no weeding was done, the number of weeds increased, leading to higher weed density. Conversely, areas covered with polythene mulch shown a significant reduction in weed population, attributed to decreased light transmission beneath the soil surface, hindered weed seed germination as well as growth and development (Wickramarathne *et al.*, 2021).

Table 2. Weed community recorded in unweeding plot at the experimental field of chilli

Common name	Scientific name	Family	Weed density in control plot (% m^{-2})
Barnyard grass	*Echinochloa crussgalli*	Poaceae	6
Bermuda grass	*Cynodon dactylon*	Poaceae	11
Goose grass	*Eleusine indica*	Poaceae	10
Nut grass	*Cyperus rotundus*	Cyperaceae	60
Harkuch	*Enhydra fluctuans*	Asteraceae	1
Prostate spurge	*Euphorbia parviflora*	Euphorbiaceae	3
Pig weed	*Amaranthus viridis*	Amaranthaceae	2
Creeping water primrose	*Jussiaea repens*	Onagraceae	1
Common purslane	*Portulaca oleracea*	Portulaceae	5
Cocklebur	*Xanthium indicum*	Asteraceae	1

Weed density, fresh and dry weight of weeds

The effect of various polythene mulches on weed density, weed biomass in chilli field were found as illustrated in Table 3. The silver on black polythene mulch exhibited the lowest weed density (1.7 in m^{-2} 2021, 9.0 m^{-2} in 2022 and 5.4 m^{-2} as pooled), the minimum fresh weight of weed (36.3g m^{-2} in 2021, 125g m^{-2} in 2022 and 80.7g m^{-2} as pooled) and as well as the minimum dry weight of weed (32.7g m^{-2} in 2021, 6.3g m^{-2} in 2022 and 19.3g m^{-2}). Conversely, the unweeded treatment (control) showed the highest weed density (47.7 m^{-2} in 2021, 52.3 m^{-2} in 2022 and 50.0 m^{-2} as pooled), the maximum fresh weight of weed (1135.3g m^{-2} in 2021, 1076.7g m^{-2} in 2022 and 1106.0g m^{-2} as pooled) and maximum dry weight of weed (351.7g m^{-2} in 2021, 365g m^{-2} in 2022 and 358.4g m^{-2} as pooled). This disparity could be attributed to the ability of polythene mulches to restrict weed emergence solely through the punched holes, with no weed was found underneath the polythene mulch. By reducing the weed growth and density in the field, polythene mulch performs to access resources and flourish without competition, ultimately leading to optimal growth and yield of chilli. The findings are in consonance with the results of Kanthaswamy and Venkadeswaran (2020) and Sathiyamurthy *et al*. (2017).

Table 3. Effect of polythene mulch on weed density, weeds fresh and dry weight of chilli

Treatment	Weed density (No. m^{-2})			Fresh weight of weeds (g m^{-2})			Dry weight of weeds (g m^{-2})		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1	8.0	4.7	6.4	152.7	159.0	155.9	50.3	31.0	40.7
T_2	5.7	6.3	6.0	122.7	140.7	131.7	41.0	20.3	30.7
T_3	1.7	9.0	5.4	36.3	125.0	80.7	32.7	6.3	19.3
T_4	9.3	11.3	10.3	172.3	210.0	191.2	66.3	37.3	51.8
T_5	47.7	52.3	50.0	1135.3	1076.7	1106.0	351.7	365.0	358.4
CV (%)	7.45	7.84	9.72	14.11	5.08	9.83	2.26	2.31	3.73
LSD (0.05)	2.39	3.11	1.84	86.69	32.72	39.71	9.03	4.61	4.54

Treatment means followed by the same letter(s) do not differ significantly at 5% level of probability by LSD test.

T_1 = Transparent polythene mulch, T_2 = Black polythene mulch, T_3 = Silver on black polythene mulch, T_4 = Blue polythene mulch and T_5 = Unweeded (Control)

Weed control index and weed control efficiency

Weed control index and weed control efficiency of chilli were influenced by the application different polythene mulch as depicted in Table 4. The silver on black polythene mulch treatment achieved the maximum weed control index (94.61%)

and weed control efficiency (89.2%) followed by black polythene mulch having weed control index (91.43%) and weed control efficiency (88.0%) while the blue polythene mulch treatment exhibited the lowest weed control index (85.55%) and weed control efficiency (79.4%). The black polythene mulch inhibits weed germination, growth & development and weed infestation by preventing the transmittance of photosynthetic light (Shehata *et al.*, 2019).

Table 4. Effect of polythene mulch on weed control index and weed control efficiency of chilli (Pooled of two years

Treatment	Weed control Index (%)	Weed control efficiency (%)
T_1 (Transparent polythene mulch)	88.64	87.2
T_2 (Black polythene mulch)	91.43	88.0
T_3 (Silver on black polythene mulch)	94.61	89.2
T_4 (Blue polythene mulch)	85.55	79.4
T_5 (Unweeded)	-	-

Plant height, number of brunches and number of fruits per plant

The results demonstrated a significant impact of polythene mulches on various growth parameters of chilli compared to the unweeding as depicted in Table 5. The treatment silver on black polythene mulch gave the tallest plant (118.8 cm in 2021 and 104.7 cm in 2022 and 111.5 cm as pooled), the highest number of branches per plant (14.7 in 2021, 13.3 in 2022 and 14.0 as pooled) and maximum number of fruits per plant (583.3 in 2021, 478 in 2022 and 530.7 as pooled). This was closely followed by the treatment black polythene mulch having plant height (113.7 cm in 2021, 98 cm in 2022 and 105.8 cm as pooled), number of branches per plant (11.3 in 2021 and 11.7 in 2022 and 11.5 as pooled) and number of fruits per plant (548.3 in 2012, 468 in 2022 and 508.2 as pooled). On the contrary, the unweeded plot showed the shortest plant (77 cm in 2021, 69 cm in 2022 and 73.0 cm as pooled), fewer number of branches per plant (5.7 in 2021, 5.3 in 2022 and 5.5 as pooled), the lowest number of fruits per plant (131.3 in 2021, 128.7 in 2021 and 130.0 as pooled). This difference can be attributed to the favorable soil moisture (90-100% field capacity) conditions facilitated by the use of polythene mulches, which enhanced to lead the higher availability of nutrients (around15% increase) for improved growth, minimized evaporation losses (25-50% total amount of water) and maintaining favorable temperature (around10^{0}C reduced in desert and increasing cool) (Iqbal *et al.*, 2020). Additionally, weed suppression may have contributed to these observed effects (Shehata *et al.*, 2019). Similar conclusions were drawn in previous studies by Wickramarathne *et al*. (2021) and Mahadeen (2014).

Table 5. Effect of polythene mulch on plant height, number of branches and number of fruits per plant of chilli

Treatment	Plant height (cm)			No. of branches per plant			No. of fruits per plant		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1	103.0	92.7	97.8	8.7	8.3	8.5	507.7	476.3	492.0
T_2	113.7	98.0	105.8	11.3	11.7	11.5	548.3	468.0	508.2
T_3	118.8	104.7	111.5	14.7	13.3	14.0	583.3	478.0	530.7
T_4	100.7	80.7	90.7	7.7	10.0	8.8	482.7	377.0	429.8
T_5	77.0	69.0	73.0	5.7	5.3	5.5	131.3	128.7	130.0
CV (%)	2.37	2.31	2.60	5.38	13.06	12.02	4.04	8.61	6.69
LSD (0.05)	7.68	2.50	4.67	0.97	2.39	1.41	34.31	62.5	33.92

Treatment means followed by the same letter(s) do not differ significantly at 5% level of probability by LSD test. T_1 = Transparent polythene mulch, T_2 = Black polythene mulch, T_3 = Silver on black polythene mulch, T_4 = Blue polythene mulch and T_5 = Unweeded (Control).

Fruit size and individual fruit weight

The impact of various polythene mulches on fruit size and individual fruit weight per plant of chilli were summarized in Table 6. Higher fruit size (7.81 cm X 1.26 cm in 2021, 7.04 cm x 0.62 cm in 2022 and 7.42 cm X 0.94 cm as pooled) and maximum individual fruit weight (3.90 g in 2021, 3.20 cm in 2022 and 3.6 g as pooled) were obtained from silver on black polythene mulch followed by black polythene mulch having fruit size (7.58 cm x 1.16 cm in 2021, 7.04 cm x 0.59 cm in 2022 and 7.31 cm X 0.87 cm as pooled) and individual fruit weight (3.60 g in 2021, 3.07 g in 2022 and 3.3 g as pooled). The smallest fruit (5.43 cm x 0.69 cm in 2021, 5.45 cm x 0.39 cm in 2022 and 5.44 cm X 0.54 cm as pooled) and the lowest fruit weight (2.0 g in 2021, 2.07 g in 2022 and 2.0 g as pooled) were recorded in unweeded plot. This variance can be attributed to the beneficial effects (maintain optimum soil moisture, temperature and aeration) of polythene mulches on soil physical properties (modification of soil texture, bulk density, temperature and aeration) in rhizospheric zone of the chilli plants (Santosh *et al.*, 2022).

Table 6. Effect of polythene mulch on fruit size and single fruit weight of chilli

Treatment	Fruit length (cm)			Fruit width (cm)			Single fruit weight (g)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1	7.14	6.35	6.74	1.01	0.58	0.79	3.13	2.87	3.0
T_2	7.58	7.04	7.31	1.16	0.59	0.87	3.60	3.07	3.3
T_3	7.81	7.04	7.42	1.26	0.62	0.94	3.90	3.20	3.6
T_4	6.97	6.22	6.59	0.99	0.55	0.77	3.03	2.47	2.8
T_5	5.43	5.45	5.44	0.69	0.39	0.54	2.0	2.07	2.0
CV (%)	2.06	3.53	3.34	9.04	10.32	8.43	8.14	3.09	6.13
LSD (0.05)	0.27	0.43	0.27	0.17	1.06	0.08	0.48	1.59	0.22

Treatment means followed by the same letter(s) do not differ significantly at 5% level of probability by LSD test. T_1 = Transparent polythene mulch, T_2 = Black polythene mulch, T_3 = Silver on black polythene mulch, T_4 = Blue polythene mulch and T_5 = Unweeded (Control)

Fruit yield

The effect of different polythene mulches on the fresh fruit yield per plant, fresh red fruit and dry fruit yield of chilli were statistically significant as presented in Table 7. Notably, silver on black polythene mulch treatment exhibited the maximum number of fruits per plant (1048.3 g in 2021, 939.3 g in 2022 and 987.0 g as pooled), fresh red fruit yield (22.4 t ha^{-1} in 2021, 18.1 t ha^{-1} in 2022 and 20.3 t ha^{-1} as pooled) and dry fruit yield (8.13 t ha^{-1} in 2021, 7.40 t ha^{-1} in 2022 and 7.77 t ha^{-1} as pooled) followed by the treatment black polythene mulch which gave number of fruits per plant (988 in 2021, 925.7 in 2022 and 963.7 as pooled), fresh red fruit yield (20.8 t ha^{-1} in 2021, 17.9 t ha^{-1} in 2022 and 19.4 t ha^{-1} as pooled) and dry fruit yield (7.50 t ha^{-1} in 2021, 7.13 t ha^{-1} in 2022 and 7.32 t ha^{-1} as pooled). On the other hand, the unweeded treatment produced the minimum number of fruits per plant (203.3 in 2021, 205.3 in 2022 and 204.0 as pooled), the lowest fresh red fruit yield (6.6 t ha^{-1} in 2021, 7.2 t ha^{-1} in 2022 and 5.9 t ha^{-1} as pooled) and dry fruit yield (2.23 t ha^{-1} in 2021, 2.30 t ha^{-1} in 2022 and 2.27 t ha^{-1} as pooled). The applied silver on black polythene mulch led to a remarkable increase in dry fruit yield (242.29%) followed by black polythene mulch (222.47%) over the unwedded treatment. This improvement can be attributed to the ability of polythene mulches to create a micro-climate conducive to crop growth while inhabiting weed growth & development and favorable environmental condition for crop cultivation (Iqbal *et al.,* 2020).

Table 7. Effect of polythene mulch on fruit yield of chilli

Treatment	Fruit yield per plant (g)			Fresh red fruit yield (t ha^{-1})			Dry fruit yield (t ha^{-1})			% dry fruit yield (pooled) increases over control (pooled)
	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	
T_1	936.3	837.0	886.7	18.7	16.5	17.6	6.77	6.27	6.51	186.78
T_2	988.0	925.7	963.7	20.9	17.8	19.4	7.50	7.13	7.32	222.47
T_3	1048.3	939.3	987.0	22.4	18.1	20.3	8.13	7.40	7.77	242.29
T_4	907.3	781.3	844.3	18.5	16.6	17.6	6.70	6.20	6.45	184.14
T_5	203.3	205.3	204.0	6.6	7.2	5.9	2.23	2.30	2.27	-
LSD (0.05)	17.66	60.19	33.48	2.93	0.73	1.51	0.77	0.54	0.42	-
CV (%)	1.15	4.33	3.55	8.91	2.53	6.07	6.53	4.88	5.67	-

Treatment means followed by the same letter(s) do not differ significantly at 5% level of probability by LSD test. T_1 = Transparent polythene mulch, T_2 = Black polythene mulch, T_3 = Silver on black polythene mulch, T_4 = Blue polythene mulch and T_5 = Unweeded (Control); Y_1 = 2021, Y_2 = 2022.

Number of seeds per fruit, 1000-seed weight and seed yield

The results of various polythene mulches on the number of seeds per fruit, 1000 seed weight and seed yield of chilli were found significant (Table 8). The utilization of silver on black polythene mulch on chilli resulted in the maximum number of seeds per fruit (49.0 in 2021 and 47.5 in 2022 and 48.25 as pooled), higher 1000-seed weight (4.27 g in 2021, 4.48 g in 2022 and 4.38 g as pooled) and maximum seed yield (478.6 ha^{-1}in 2021, 486.3 ha^{-1}in 2022 and 482.3 kg ha^{-1} as pooled) which were followed by the treatment black polythene having number of seeds per fruit (46.0 in 2021 and 45.0 in 2022 and 45.5 as pooled), 1000-seed weight (3.97 g in 2021, 4.0 g in 2022 and 3.99 g as pooled) and seed yield (467.3 kg ha^{-1}in 2021, 472.7 kg ha^{-1}in 2022 and 470.0 kg ha^{-1} as poled). Conversely, the unweeded treatment exhibited the lowest number of seeds per fruit (34.3 in 2021, 35.5 in 2022 and 34.92 as pooled), the lowest 1000- seed weight (2.87 g in 2021 and 3.07 g in 2022 and 2.97 g as pooled) and seed yield (114.3 kg ha^{-1} in 2021, 127.0 kg ha^{-1} in 2022 and 118.7 kg ha^{-1}). Notably, the silver on black polythene mulch maximum treatment demonstrated a substantial increase in seed yield (306.3%) compared to unweeding treatment. This enhancement can be attributed to the ability of polythene mulches to establish a favorable hydrothermal soil regime and maintaining a weed free environment.

Table 8. Effect of polythene mulch on no. of seed per fruit, 1000 seed weight and seed yield of chilli

Treatment	No. of seeds per fruit			1000 seed weight (g)			Seed yield (kg ha^{-1})			% seed yield increase over control
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	
T_1	42.0	43.5	42.75	3.75	3.71	3.73	399.7	419.7	409.7	245.2
T_2	46.0	45.0	45.5	3.97	4.0	3.99	467.3	472.7	470.0	295.9
T_3	49.0	47.5	48.25	4.27	4.48	4.38	478.6	486.0	482.3	306.3
T_4	40.7	42.0	41.33	3.53	3.57	3.55	412.3	433.0	422.7	256.1
T_5	34.3	35.5	34.92	2.87	3.07	2.97	114.3	123.0	118.7	-
LSD (0.05)	0.88	3.95	1.25	0.26	0.39	0.66	9.78	21.22	11.76	-
CV (%)	1.09	2.87	2.43	3.74	5.50	4.65	1.39	2.91	2.54	-

Treatment means followed by the same letter(s) do not differ significantly at 5% level of probability by LSD test. T_1 = Transparent polythene mulch, T_2 = Black polythene mulch, T_3 = Silver on black polythene mulch, T_4 = Blue polythene mulch and T_5 = Unweeded (Control)

Conclusion

Based on the two years' pooled findings of the present study, it is concluded that silver on black polyethene mulch (30μ thickness) can be effectively used in chilli field to obtain the maximum fresh red fruit yield (20.30 t ha^{-1}) as well as dry fruit yield (7.77 t ha^{-1}) along with the highest seed yield (482.30 kg ha^{-1}) of chilli. Additionally, this treatment also showed the highest weed control index (94.61%) and weed control efficiency (89.2%) in Grey Terrace Soil of Madhupur Tract (AEZ-28). Therefore, uses of silver on black polythene mulch can be considered as the optimal weed management approach for enhancing chilli production in the study area.

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