Effectofdifferentmulchingmaterialsonyieldandquality of litchi grown in Nagaland

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ABSTRACT

To know the effect of mulching on litchi in Nagaland, an experiment was conducted with different organic and inorganicmulchmaterialsviz.,T_1(Blackpolythene),T_2(Whitepolythene),T_3(drygrass),T_4(Paddystraw),T_5(Dry Banana leaves), T_6(Banana pseudo stem mat), T_7(Leguminous cover crop- Soyabean) and T_8(No mulch). The mulchmaterialswereappliedtosoilsurroundingtheplantstem,inthemonthofSeptember2020-21to2021-22in theresearchexperimentalblockofHorticulturedepartment,SchoolofAgricultureSciencesandRuralDevelopment, NagalandUniversity,Medziphemacampus,Nagaland.Amongdifferentmulches,blackpolytheneshowed27.56& 30.07N,4.19&5.70Pand14.87&11.67Kkg/hafollowedbywhitepolythenemulchwith22.39&24.25N,4.18 &6.24Pand18.78&16.68Kkg/haavailabilityin2021&2022respectivelywhile,blackpolythenemulchshowed highpercentofsoilmoisturein2021(14.80%)and2022(15.50%)retentionsurroundingthetree.Flowering(74.44%), fruitset(36.78%),fruitretention/panicle(13.53),averagefruitweight(18.23g)andyield/tree(18.00kg/tree)was recorded highest in trees under black polythene mulch, which is on par with banana pseudo stem mat (72.34%, 36.06%,13.10,18.28g&17.10kg/tree)followedbysoyabeancovercrop(72.11%,35.17%,12.86,15.47g&12.46 kg/tree) mulching. Highest fruit cracking (16.70%) was recorded under control compared to other treatments.

***Keywords*:** Flowering,fruiting, litchi,mulching,N-P-K, soilmoisture, yield

INTRODUCTION

Litchiisconsideredasthequeenofsub-tropical fruits due to its excellent quality *viz*, juicy aril havingexcellentsugarandacidblend,characteristic pleasant flavour and attractive colour and also nutritional value (Pande *et al.,* 2005).It is a sub-tropicalevergreenfruittree,needshighlyspecific climaticrequirementsforimprovingthefruityield and quality. Due to this reason, its cultivation is restrictedtofewsubtropicalcountriesintheworld, where it is grown commercially (Sharma and Kathiravan, 2009). The main litchi growing countries are China, Israel, Australia, Thailand, Taiwan, India, Vietnam, parts of Africa and at higherelevationsinMexicoandCentralandSouth America. India ranks second in the world next to Chinainlitchiproduction(Sahni*etal.*,2020).In Nagaland,cultivarslikeChina,Shahi,andTejpur litchi are the varietiesare grownand cultivar 'Shahi' being predominant in the state. Nagaland hasagoodpotentialityofproducinglitchi especiallyinthefoothillswheretemperatureof4-12°C is existfor a month or more. The foothills and midhills of Dimapur, Mokokchung, Wokha, Peren, Kohima and Zunhebeto districts are also congenial for litchi cultivation. Fruit maturity in this state is quite late which comes in the market up to the last week of June.

Cronje and Mosturt (2010) stated that soil moistureactsanimportantroleinlitchicultivation withhighyieldandquality.Moisturedeficiencyat thetimeoffloweringseverelydisturbsthefruitset and retention (Carr and Menzel, 2014). Soil moisture fluctuations during fruit growth cause seriousreductionsinindividualfruitweightandin severe cases may lead to fruit cracking.This reduces the fruit quality, ultimately crop productivity and marketing.Conservationofsoilmoisturereserves the key interventions for bearing behaviour and quality production in litchi (Kaur and Kaundal, 2009). Physiological disorders such as poor fruit set,fruitdrop,fruitcrackingandsunburncanbe

minimizedwith properwatermanagement. Moisture conservation through mulching using dried leaves, plant partsor polythene sheet mulches has been found useful. Frequency of irrigation is reduced by adopting mulching (Shirgure *et al.*, 2003).Thus, the present experiment was conducted to observe the effect of different mulch materials onnutritionalcontentoflitchisoil,yieldandquality of fruits.

MATERIALSANDMETHODS

The present investigation has been conducted during2020-21 to 2021-22 in the research experimental block of Horticulture department, Schoolof Agriculture Sciencesand Rural Development,NagalandUniversity,Medziphema campus, Nagaland. Twenty two years oldplants of*China*varietyoflitchiofuniformsizeandvigour wereselectedforthestudy.Thetrailwaslaidout with8-mulchingtreatments,*viz.*,blackpolythene, whitepolythene,drygrass,paddystraw,drybanana leaves,bananapseudostemmat,leguminouscover cop with soyabean and no mulch following Randomized Block Design (RBD) with three replications and three plants in each. The mulch materials were applied around the plant covering 2m radius. The thickness of black and white polythene was 40 micron. Thickness oforganic mulch materials was 4 cm. Different mulching treatmentswereappliedon15thSeptemberineach year.Weatherparameterduringthestudyhasbeen presented in the **Annexure 1**. The prevailing climatic condition of Medziphema Campus is humidandfallsundersub-tropicalregionwithan average annual rainfall ranging from 2000-2500 mm,withpredominantlyhighhumidityof70-90%. Themeantemperaturerangesfrom21^{0}Cto32^{0}C duringsummerandduringwinterfrom10^{0}Cto15^{0}C,ra relygoesbelow8^{0}Cinwinter.Thesoilofthe experimentalsitewassandyloam,acidicinnature with mean pH of 4.4.

Observation taken on soil parameters like available moisture per cent, available N,P & K, yield attributing parameters like and qualitative parameters like TSS, total sugar and titratable acidity were observed.

AnalysisofsoilNPK

Soilsampleswerecollectedbeforeapplication ofmulchmaterialandafterharvestofthecropin each treatment and a composite sample was prepared,thoroughlymixedanalysedtodetermine thenutrientstatusofthesoil.Thesoilsampleswere spreadevenlyandbigsoilclodswerecrushed.After drying,poundingwasdonewithwoodenpestleand mortar to break the soil aggregates. The crushed sampleswerepassedthrough2mm(8mesh)sieve. Available nitrogen was estimated by Kjeldahl's methodasdescribedbyJackson(1973).Available phosphoruswas determined by Olsen's method, using spectrophotometer as described by Jackson (1973). Available potash was extracted and estimated by neutral normal ammonium acetate method using flame photometer (Jackson, 1973).

Observation on flowering per cent, fruit set, fruitdrop,fruitweight,fruitcrackingandyieldwere madefollowingthe methoddescribedby Rangkham (2015).

Flowering per cent: Five randomly selected flowerpanicleswerecollectedfromeach replicationandtheaveragevaluewasworkedout and expressed in percentage.

Fruit set: The total number of flowers at full bloomandtheinitialnumberoffruitsattheendof blooming stage on the labelled panicles in all treatments were counted and recorded then the percentage of fruit set was calculated as the following equation.

$$\text{Fruit set}(\%) = \frac{\text{No. of fruit lets set}}{\text{Total number of female flowers}} \times 100$$

Fruit drop: Number of fruits present on the randomlyselectedbranchesofeachreplicationof each treatment trees at the time of fruit set were recorded and number of fruits retained on these branchestillmaturitywasrecorded.Therecorded data was expressed as per cent fruit drop.

$$\text{Fruit drop}(\%) = \frac{\text{Final fruit retention}}{\text{Initial fruit set}} \times 100$$

Fruit weight: Weight of ten fruits from each treatment per replication were randomly selected and recorded by weight on top pan balance and averageweightoffruitwasexpressedingrams(g).

Fruitcracking: Observationsonfruitcracking were recorded from first May, at an interval of 7 days.Forrecordingthedataonfruitcrackingone panicle was tagged in each of the four directions (east,west,northandsouth)oftree.Percentagefruit crackingwascalculatedonthebasisofobservations

recorded on four panicles. The percentage fruit crackinginaparticulartreatmentwasworkedout by using the following formula

$$\text{Fruit cracking}(\%)=\frac{\text{No. of fruits cracked per panicle at harvesting stage}}{\text{No. of fruits retained per panicle at harvesting stage}}\times 100$$

Yield : The fruits were harvested from each replication and all the fruits from the individual treeswerepickedmanuallyandcollectedunderthe trees.Thetotalweightofthemarketablefruitsper tree was recorded using a pan balance of 5kg capacityandthedatawereexpressedinkgpertree.

Fruitqualitymeasurement

TSS: Total Soluble Solids, in the juice of representative sample were determined by using Digital refractometer (range of 0-32^0 Brix) and expressed in degree brix (^{0}B).The fruit juice was extracted from the mature fruits and the total soluble solids (TSS) were measured using a handheld refractometer,afterpriorcalibrationusingdistilled water.Aftereachtest,theprismplatewascleaned with distilled water and wiped with a soft tissue. ThevaluewasrecordedandTSSwasexpressedin ^{o}Brix.

Totalsugar: Totalsugarcontentoffruitjuice was determined as per Lane and Eynon method (Ranganna, 1986). 50ml filtered juice was mixed with 100ml distilled water and neutralized with 0.1N NaOH solution using phenolphthalein as indicatorandthesolutionwasallowedtostandfor ten minutes.Then 8ml of potassium oxalate solution was added and total volume was made up to 250 mlbyaddingdistilledwater.5mloftheextractwas taken in burette and titrated again 10ml mixed Fehling's (5ml Fehling's solutionA+5ml Fehling's solutionB)solutionusingmethylblueasindicator. The end point is indicated by appearance of deep brickredcolourprecipitation.Calculationoftotal sugar is done with the fallowing formula :

$$\text{Total sugar}\,(\%)=\frac{\text{Factor of Fehling's solution}\times\text{Dilution factor}}{\text{Titre value}\times\text{wt of sample taken}}\times 100$$

Where,factorforFehling'ssolutiondenotesthegramofinvertsugar Factor = (Titre value × 2.5)/100

Titratable acidity: Pulp (20 g) from 15 fruit withoutsymptomsofdiseasewashomogenizedin agrinderandthesupernatantphasewascollected toanalyzeTA.Fivemlaliquotwasmixedwithone totwodropsofphenolphthaleinandwastitrated against0.1NNaOH.Theappearanceoflightpink colourmarkedasendpointaspermethoddescribed inthemanualofanalysingoffruitsandvegetables product by Ranganna (1991). The acidity was expressed in percentage by following formula:

$$\text{Titratable acidity}(\%)=\frac{\text{Titre value}\times\text{Normality of alkali}\times\text{Equivalent weight of acid}}{\text{Volume of sample taken}}\times 1000$$

Methodofstatisticalanalysis

The mean values of different treatments were analyzed with the statistical software –OPSTAT (Sheoran *et al.,* 1998) along with corresponding standard error of mean (S.E.m±).

RESULTSANDDISCUSSION

Soilmoisturecontent(%)

Thedataonsoilmoisturecontenthasbeen presented in the Table 1 and revealed that during 2020-21, the increased soil moisture retention percentagerangefrom-1.36to14.80percentafter mulchingwithdifferentmaterials.Itwasrecorded maximum(14.80%)inT_1(Blackpolythenemulch) whereasitwasminimum(-1.36%)intreesunder T_8(no-mulch).Asimilartrend was recorded during 2021-22,maximum(15.50%)underthetreatment of T_1 (Black polythene mulch) whereas it was minimum (-2.70 %) in T_8 (no-mulch). It may be due to higher percentage of moisture retaining abilityunderplasticmulches,duetolesslossfrom soil. The water vapours that loss from the soil surfacegetscachedintheplasticfilmanddropped back to the soil surface which improves the soil moistness content in the near root zone (Khan *et al*. 2016).

Table1:Effectofvariousmulchingmaterialonavailablesoilmoisture&nutrients

Treatments	Soilmoisture(%)						AvailablesoilNitrogen(kg/ha)					
	2021			2022			2021			2022		
	Before mulch	After mulch	Change	Before mulch	After mulch	Change	Before mulch	After mulch	Change	Before mulch	After mulch	Change
T_1:(Blackpolythenemulch)	11.25	26.05	14.80	11.90	27.40	15.50	386.50	414.06	27.56	350.17	380.24	30.07
T_2:(Whitepolythenemulch)	11.88	23.94	12.06	12.50	25.00	12.50	342.17	364.56	22.39	333.21	357.46	24.25
T_3:(Drygrassmulch)	12.29	20.48	08.19	12.36	20.41	08.05	344.50	351.94	07.44	317.97	325.78	07.81
T_4:(Paddystrawmulch)	11.87	21.33	09.46	12.97	22.80	09.83	357.20	372.47	15.27	340.92	358.66	17.74
T_5:(Drybananaleavesmulch)	10.21	15.83	05.62	10.40	17.86	07.46	340.56	345.71	05.15	322.83	329.27	06.44
T_6:(Bananapseudostem mat mulch)	12.46	26.41	13.95	12.20	26.10	13.90	366.50	376.50	10.00	360.18	368.17	07.99
T_7:(Leguminouscovercrop-Soyabeanmulch)	10.18	14.25	04.07	10.67	16.71	06.04	319.70	339.00	19.30	308.56	325.58	17.02
T_8:(No- mulch)	12.92	11.56	-01.36	12.40	9.70	-02.70	331.42	336.22	04.80	328.61	331.96	03.35

Table2:Effectofvariousmulchingmaterialonavailablesoilnutrients

Treatments	AvailablesoilP_2O_5(kg/ha)						AvailablesoilK_2O(kg/ha)					
	2021			2022			2021			2022		
	Before mulch	After mulch	Change	Before mulch	After mulch	Change	Before mulch	After mulch	Change	Before mulch	After mulch	Change
T_1:(Blackpolythenemulch)	48.54	52.73	4.19	47.28	52.98	5.70	146.94	161.81	14.87	141.83	153.50	11.67
T_2:(Whitepolythenemulch)	43.83	48.01	4.18	41.40	47.64	6.24	155.62	174.40	18.78	152.64	169.32	16.68
T_3:(Drygrassmulch)	46.13	46.83	0.70	44.01	45.21	1.20	143.22	146.11	2.89	141.58	142.96	1.38
T_4:(Paddystrawmulch)	49.11	52.21	3.10	44.56	46.17	1.61	151.28	164.30	13.02	149.54	161.27	11.73
T_5:(Drybananaleavesmulch)	43.18	43.58	0.40	40.72	41.72	1.00	144.46	146.97	2.51	142.50	145.17	2.67
T_6:(Bananapseudostem mat mulch)	41.97	43.82	1.85	38.23	40.94	2.71	135.78	145.23	9.45	132.28	140.81	8.53
T_7:(Leguminouscovercrop-Soyabeanmulch)	50.17	52.74	2.57	46.28	49.30	3.02	139.50	147.50	8.00	136.82	141.50	4.68
T_8:(No- mulch)	41.61	41.91	0.30	37.94	38.50	0.56	137.64	140.24	2.60	136.91	138.24	1.33

Table3:Effectofvariousmulchingmaterialonfloweringandfruitparameters

Treatments	Floweringpercentage (%)			Fruitsetpercentage/ panicle (%)			Fruitdroppercentage (%)			Fruit retention/ panicle(number)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1:(Blackpolythenemulch)	73.15	75.73	74.44	35.12	38.45	36.78	69.00	67.19	68.09	12.99	14.08	13.53
T_2:(Whitepolythenemulch)	71.45	72.61	72.03	36.00	37.22	36.61	72.90	72.60	72.75	12.50	13.70	13.10
T_3:(Drygrassmulch)	64.12	65.66	64.89	32.50	34.15	33.32	73.33	74.66	73.99	11.30	12.70	12.00
T_4:(Paddystrawmulch)	66.33	69.74	68.03	34.99	35.45	35.22	75.41	73.50	74.45	12.00	12.99	12.49
T_5:(Drybananaleavesmulch)	65.00	65.87	65.43	32.33	34.12	33.22	78.08	75.93	77.00	11.56	12.41	11.98
T_6:(Bananapseudostem mat mulch)Soyabean	70.20	74.49	72.34	36.00	36.12	36.06	72.44	70.63	71.53	12.88	13.33	13.10
T_7:(Leguminouscovercrop-mulch)	72.00	72.22	72.11	34.93	35.42	35.17	76.70	73.00	74.85	12.43	13.30	12.86
T_8:(No- mulch)	40.30	41.58	40.94	30.63	32.20	31.41	86.52	81.12	83.82	9.23	11.90	10.56
SEm±	**0.28**	**0.58**	**0.69**	**0.70**	**0.01**	**0.51**	**0.91**	**0.90**	**1.01**	**0.39**	**0.04**	**0.33**
CD@5%	**0.95**	**1.98**	**2.35**	**2.40**	**0.04**	**1.73**	**3.10**	**2.75**	**3.43**	**1.35**	**0.16**	**1.12**

Table4:Effectofvariousmulchingmaterialonfruitqualityattributes

Treatments		Fruitweight (g)			Fruit cracking percentage (%)			Yield (kg/tree)		
		2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1:(Blackpolythenemulch)		17.52	18.95	18.23	13.26	13.04	13.15	17.34	18.67	18.00
T_2:(Whitepolythenemulch)		16.33	16.75	16.54	13.51	13.20	13.35	16.59	17.57	17.08
T_3:(Drygrassmulch)		12.89	13.14	13.01	13.00	13.90	13.45	12.46	13.19	12.82
T_4:(Paddystrawmulch)		16.21	16.00	16.10	13.94	13.75	13.84	14.28	14.34	14.31
T_5:(Drybananaleavesmulch)		12.24	12.60	12.42	15.16	14.18	14.67	12.02	12.25	12.13
T_6:(Bananapseudostemmatmulch)	18.00	18.56	18.28	13.68	13.70	13.69	17.00	17.21	17.10	
T_7:(Leguminouscovercrop-Soyabean	**mulch)**	15.43	15.52	15.47	13.70	13.79	13.74	12.42	12.50	12.46
T_8:(No- mulch)		10.42	9.33	9.87	16.23	17.18	16.70	10.53	11.49	11.01
SEm±		**0.19**	**1.01**	**0.35**	**0.38**	**0.004**	**0.31**	**0.36**	**0.22**	**0.24**
CD@5%		**0.67**	**3.43**	**1.21**	**1.29**	**0.015**	**1.08**	**1.25**	**0.77**	**0.83**

Table5:Effectofvariousmulchingmaterialonbiochemicalattributesoflitchi

Treatments	TSS(°B)			Totalsugar(%)			TitraTableacidity(%)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1:(Blackpolythenemulch)	17.82	17.50	17.66	16.89	16.14	16.51	0.55	0.45	0.50
T_2:(Whitepolythenemulch)	17.19	16.55	16.87	15.50	14.64	15.07	0.50	0.50	0.50
T_3: (Dry grass mulch)	14.62	15.20	14.91	13.84	13.76	13.80	0.40	0.55	0.47
T_4:(Paddystrawmulch)	15.00	15.75	15.37	14.05	14.07	14.06	0.55	0.62	0.58
T_5: (Dry banana leaves mulch)	14.26	15.30	14.78	12.38	12.69	12.53	0.67	0.70	0.68
T_6:(Bananapseudostemmatmulch)	15.61	14.75	15.18	14.97	14.34	14.65	0.44	0.50	0.47
T_7:(Leguminouscovercrop-Soyabeanmulch)	14.87	14.00	14.43	12.56	11.86	12.21	0.50	0.60	0.55
T_8:(No- mulch)	14.52	13.65	14.08	12.27	12.59	12.43	0.70	0.75	0.72
SEm±	**0.61**	**0.44**	**0.40**	**0.12**	**0.49**	**0.24**	**0.03**	**0.02**	**0.03**
CD@5%	**2.10**	**1.51**	**1.37**	**0.43**	**1.67**	**0.83**	**0.11**	**0.08**	**0.12**

Availablenitrogencontentinthesoil(kg/ha)

During 2020-21, soil nitrogen content was increasedfrom4.80to27.56kg/haaftermulching with different organic and in organic materials, it wasrecordedmaximumunderthetreatmentofT_1 (blackpolythenemulch)*i.e*.,27.56kg/hafollowed by $T_2$and T_7(whitepolythenemulchand leguminouscovercrop-soyabeanmulch)*i.e*.,22.39 and 19.30 kg/ha respectively, whereas minimum (4.80kg/ha)withT_8(no-mulch)treatment.Asimilar trendwasrecordedduring2021-22,wherenitrogen content increased from 3.35 to 30.07 kg/ha after mulching (Table 1).

Availablephosphorusandpotassiumcontentin the soil (kg/ha)

During 2020-21, soil phosphorus content was increased from 0.30 to 4.19 kg/ha after mulching with different organic and in organic materials, it wasrecordedmaximumunderthetreatmentofT_1(bla ckpolythenemulch) *i.e*.,4.19kg/hafollowed by $T_2$and T_4(white polythene mulch and paddy straw mulch) *i.e*., 4.18 and 3.10 kg/ha, whereas minimum(0.30 kg/ha)withT_8(no-mulch) treatment. A similar trend was recorded during 2021-22,wherephosphoruscontentincreasedfrom 0.56 to 6.24 kg/ha after mulching. Among the treatments maximum (6.24 kg/ha) soil available phosphorus recorded under T_2(white polythene mulch)followedbyT_1(blackpolythenemulch)*i.e*., 5.70kg/ha,whereasitwasminimum(0.56kg/ha) with T_8(no-mulch) treatment (Table 2).

During2020-21,soilpotassiumcontentwas increasedfrom2.51to18.78kg/haaftermulching with different organic and in organic materials, it wasrecordedmaximumunderthetreatmentofT_2(wh itepolythenemulch)*i.e*.,18.78kg/hafollowed by T_1(black polythene mulch) *i.e*., 14.87 kg/ha, whereasminimum(2.51kg/ha)withT_5(drybanana leaves mulch) treatment. A similar trend was recordedduring2021-22,wherepotassiumcontent increasedfrom1.33to16.68kg/haaftermulching. Amongthetreatmentsmaximum(16.68kg/ha)soil available potassium recorded under T_2(white polythene mulch) whereas it was minimum (1.33 kg/ha) with T_8(no-mulch) treatment (Table 2).

High availability of nutrients on soil surface under polythene film mulch was the effect of mineralizationof organiccontent (Dasand Dutta,

2018). Parallel results was also got by Duta and Majmder (2009) in *Psidium gujava*.

Floweringandfruiting

Theeffectofdifferentmulchingtreatmentswas foundtobesignificantlyinducedthefloweringin the litchi during both the years as compared to control(Table 3). Pooled data of two consecutive years, showed highest percentage (74.44 %) of floweringwasfoundinT_1(blackpolythenemulch) whichwasatparwithT_6(bananapseudostemmat mulch)andT_7(leguminouscovercrop-soyabean mulch)andthevaluewere72.34and72.11percent respectively.Thelowestflowering(40.94%)was observedinT_8 (no-mulch),The results are in line withthefindingsofMal*etal*.(2006)whoreported thatagreaternumberofflowersrecordedinplants under black polythene mulch in pomegranate cv. Ganesh.Thepooleddataof2021&2022showed thatmaximumfruitsetpercentagecontent(36.78 %)wasobservedintreatmentT_1(blackpolythene mulch) while the minimum fruit set percentage content(31.41%)wasrecordedinT_8(no-mulch). whichwasatparwithT_2(whitepolythenemulch), T_6(banana pseudo stem mat mulch), T_4(paddy straw mulch) and T_7 (leguminous cover crop-soyabeanmulch)andthevaluewere36.61,36.06, 35.22and35.17percent respectively.

Bakshi *et al.* (2014) also stated maximum number of fruits per plant recorded under black polythene mulch in strawberry cv. Chandler. It mightbeduetogoodweedcontrolwasfoundunder the effect of mulch and drip irrigation which reduced the competition for nutrients and soil moisture, it leads to better flowering and fruiting percentage.

The lowest (10.56) number of fruits retention atharvestwasrecordedinT_8(no-mulch),whereas treatments T_1 (black polythene mulch) recorded maximum (13.53) number of fruits per panicle, followed by T_2 (white polythene mulch), T6 (bananapseudostemmatmulch),T_7(leguminous covercrop-soyabeanmulch)andT_4(paddystraw mulch)*i.e.*,13.10,13.10,12.86and12.49 respectively(Table3).Singh*etal*.(2015)recorded maximumnumberoffruitsinguavacv.Allahabad safeda under plastic mulch with drip irrigation.

The data presented inTable 4 reveals that weight offruitvariedfrom9.87to18.28gwithsignificant

Annexure1:Weatherparameterduringtheperiodofstudy.

Month	Temperature(ºC)				RelativeHumidity(%)				Rainfall(mm)	
	Max.		Min.		Max.		Min.			
	2020- 21	2021- 22	2020- 21	2021-22	2020- 21	2021-22	2020- 21	2021- 22	2020-21	2021- 22
September	34.00	33.10	23.50	23.80	93.00	94.00	68.00	68.00	98.70	116.20
October	33.80	32.10	23.00	22.10	95.00	95.00	67.00	68.00	114.30	130.00
November	30.00	28.50	15.00	14.80	95.00	96.00	51.00	51.00	00.00	00.00
December	26.50	25.10	12.50	11.30	94.00	95.00	50.50	51.00	02.50	16.40
January	24.00	22.70	08.90	10.10	96.00	96.00	50.00	56.00	03.40	34.60
February	27.10	23.20	09.70	09.60	95.00	95.00	40.00	48.00	02.30	56.30
March	31.10	32.20	14.90	15.50	93.00	90.00	41.00	40.00	43.50	02.30
April	33.10	30.90	17.90	19.90	87.00	90.00	34.00	68.00	59.60	175.70
May	32.80	30.50	21.90	21.90	90.00	92.00	58.00	71.00	85.40	224.70
June	33.10	32.00	24.30	23.90	93.00	95.00	69.00	72.00	117.40	160.80

differences among the treatments. However highest fruitweight(18.28g)wasobservedinT_6(banana pseudo stem mat mulch) followed by T_1 (black polythene mulch) i.e., 18.23 g. Whereas lowest (9.87g)wasreportedinT_8(no-mulch).Ontheother hand,allthetreatmentshadasignificanteffecton fruit weight as compared to control. Kumari and Khare(2019)reportedsimilarfindingsinlitchifruit thatthefruitweight(23.5g)wasfoundmaximum in plastic mulched trees followed by dry leaves mulchedtreeshavingfruitweight(21.8g). Similarly,DasandDutta(2018)inmangorecorded that,maximumfruitweight(263.42g)underblack filmmulch.Itmaybeduetoimprovedsoilmoisture maintenanceandgoodsoiltemperaturemaintained under the mulched treatments.

Fruitcracking

Data given in Table 4 indicates that there was significanteffectofdifferentmulchingmaterialon fruitcracking.Minimumfruitcracking(13.15%) was observed in T_1 (black polythene mulch) followed byT_2(whitepolythenemulch) *i.e*.,13.35 % which was significant over all treatments and maximum cracking was observed in T_8 (un-mulched)fruitsof16.70percent.Joshi*etal*.(2011) observedsignificantreductioninfruitcrackingin litchi with the application of mulch and drip irrigation. The organic and inorganic mulching materials improved available soil moisture and nutrientsinplantbasinduetowhichthetreatments plants showed less cracking percentage.

Fruityield

The data in Table 4 depicted that effect of different mulching materials in respect to litchi yield was found to be significant due to different treatments.Theaverageyieldduringboththeyears ranged from 11.01 to 18.00 kg/tree in various treatments. Highest yield (18.00 kg/tree) was recorded in T_1(black polythene mulch) fallowed byT_6(bananapseudostemmatmulch)*i.e*.,17.10 kg/treeandthelowest(11.01kg/tree)intreesunder T_8(un-mulch).

Similarly, Bakshi *et al*. (2014) evaluated the effectofmulchingmaterialonyieldofstrawberry and reported that maximum yield per plant was underblackpolythenebecauseoflargerfruitowing tobetterhydrothermalregimeofsoilandcomplete weed-freeenvironment.DasandDutta(2018)also recorded yield (243.72 fruits/tree) in polythene mulch, while un-mulched (control) gave the minimum values (192.72 fruits/tree) in mango.

Fruitqualityparameters

ThedatapresentedinTable5showsthatallthe treatmentssignificantlyincreasedtheTotalsoluble solidscontentinthelitchi.Thepooleddataof2021 &2022showedthatmaximumTSScontent(17.66 ºB)wasobservedintreatmentT_1(blackpolythene mulch) followed by T_2(white polythene mulch) (16.87ºB)whiletheminimumTSScontent(14.08 ºB) was recorded in T_8 (un-mulched).

DasandDutta(2018)reportedmaximum(19.20 ºB)TSSinblackpolythenemulchthanun-mulched treatment(table5).Improvementinfruitqualitative attributes with various mulching treatments may be due to the result of leaf potassium and an enhancedrateof photosynthesiswhich cumulatively enhanced the fruit quality. Iqbal *et al*. (2015) also reported similar findings that the totalsolublesolidswererecordedhighestinblack polythene (10.73 ºB) followed by paddy straw mulch(10.20ºB)while,thetreatmentun-mulched controlproducedthefruitsofminimumTSS(9.70 ºB) in aonla.

ThedatapresentedinTable5showsthatallthe treatmentssignificantlyaffectedtotalsugarcontent. The pooled analysis of total sugar content indicated that maximum total sugar content (16.51 %) was found in treatment T_1 (black polythene mulch) followedbyT_2(whitepolythenemulch)(15.02%). On the other hand, minimum total sugar content (12.21%and12.43%)wasfoundintreatmentT_7 (leguminouscovercrop-soyabeanmulch)andT_8 (no-mulch).Enhancedsugarsmaybeduetoslow hydrolysisofstarchtosugarsandthegradualbuild-upofsugarsduringripeningoffruits(Kulkarniand Yewale 2012).

ThedatapresentedinTable5showsthatallthe treatments significantly reduced the titratable acidity per cent.Acritical examination of pooled dataindicatedthattreatmentsT_8(no-mulch) resultedinmaximumacidity percent(0.72) whereas,theminimumacidity(0.47%and0.47 %)wasrecordedwithT_3(drygrassmulch)andT_6(ban ana pseudo stem mulch). Iqbal *et al*. (2015) also reported that maximum titratable acidity (1.92%)wasrecordedinfruitsunderun-mulched

plantswhiletheleasttitratableacidity(1.64%)was recordedunderblackpolythenemulchinginaonla. Maximumacidity wasobtainedincontrolmaybe due to reduced cell size and cell division due to less turgor pressure and internal auxin content. Highest percentage of acidity was also recorded byEl-TawellandFarag,2015inun-mulchedplants of pomegranate.

CONCLUSION

In the case of above study, findings revealed that different mulch materials significantly affected on the soil moisture content (%), soil available nutrients(kg/ha),fruitretention,numberoffruits/ panicle and bio-chemical quality parameters of fruits. Polythene mulch, paddy straw mulch and banana pseudo stem mat mulching were found to give best results in retaining moisture, available nutrients content and fruit yield.

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