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Effect of mulching on weed management in areca nut in Andaman and Nicobar Islands

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ABSTRACT

A field investigation was conducted during October, 2018 - March, 2019 at Port Blair, to assess the impact of seven mulching practices [areca nut leaves (chopped and unchopped), husk, silver oak leaves, and black polythene] on areca nut along with weed free and weedy check treatments in randomised complete block design (RCBD) with five replications. Tree is taken as a replication. Results revealed that weed free treatment biomass (259.1 g/m^2) removed 82 kg (33.7 - 5.18 - 38.9 kg/ha of N-P-K) nutrients/ha. Black polythene mulching excluded the light supplies to weeds within 6 weeks time brought 100% weed control efficiency (WCE) and arrested the evapo-transpiration (ET) losses of weeds resulting in higher soil moisture content (SMC, %) in surface layer (0-10 cm). Organic mulches with lower WCE {77.63 (silver oak leaf mulch) - 92.93% (areca nut chopped leaf mulch)} than polythene mulching also contributed to higher SMC (0-10 cm). Mulching did not affect the SMC in deeper layer (10-30 cm). Weed free plots resulted in evaporation losses of moisture as that of ET losses of weedy check as evident form SMC. High cost of polythene mulches (` 41095/ha) when spread over its 5 year life span becomes cheaper than manual weeding (with recurring cost every year). However, due to every year organic mulching with farm generated residues soil organic matter may build up and thus enhances the water retention capacities and their ecological safety merits adoption. Soil (nutrient) and water conservation services of mulching in areca nut established in the study calls for its exploitation for weed management in islands.

Areca nut (*Areca catechu* L) or betel nut or Supari has a huge consumer base as evident from an estimated 600 million direct betel nut consumers globally and which further increases by 10–20% in the form of betel quid (paan, a preparation containing areca nut) users (Arora and Squier 2019). On account of the above global demand, areca nut cultivation was taken up by many farmers and in 2017 its area of cultivation has reached 0.956 million (m) ha with a production of 1.34 m tonnes (t) and out of this India has 46.6 and 54.0% share in the global area and production (FAOSTAT 2018). As per report of National Horticulture Board (NHB) during 2017-18, India produced 0.833 m t of areca nut from 0.497 m ha area (NHB, 2018). Andaman and Nicobar Islands (ANI) with 4625.5 ha area and 10,608 t areca nut production in 2016-17 accounts for 0.93 and 1.27% in countries area and production, respectively (DOES 2017). Tropical humid monsoonal climate (Am) of ANI with copious rainfall (300 cm), high humidity (66-93%) and isothermal (23-26^{0}C and 30-32.5^{0}C mean minimum and maximum) regime is highly congenial for areca nut cultivation. This is evident from the 36.3% (2.29 t/ha) higher average productivity than the country (1.68 t/ha). Rain fed areca nut cultivation of ANI across the topographies right from hill top to the sea coast faces several abiotic and biotic stresses and constraints and among them moisture and weeds are the most important. In sloppy lands, permanent sod cover is maintained between areca nut rows for soil conservation purpose while manipulating small area around the tree for input application (fertilizer / manure) and weeding as that of vine yards of USA (Bavougian and Read 2018).

Areca nut being a perennial crop, soil disturbance is not required as that of annual crops. Despite of high annual rainfall (300 cm in 140 days), areca nut do experience moisture stress during December-April months that gets further aggravated by the often unmanaged weeds growing along with the crop. Moisture stress limits crop nutrient uptake and they all together limits the productivity. Weed management is least emphasized in the Islands due to costly manpower, non-availability of machinery like power tillers, *etc*. The withdrawal of marketing permits to herbicides since October, 2018 in ANI has also closed the farmers use of glyphosate and paraquat for weed management. Further, herbicide use associated human, environmental problems and evolution of resistance in weed populations etc. calls for their limited or no use. In this context, mulching assumes to be a prominent technique for weed management. The annual leaf shred of 5–6 leaves (Bavappa and Murthy 1960) and fruit husk (0.8 kg/kg of fruit) of areca nut plantation generates 5-5.6 t/ha of farm wastes (Uma Maheswari *et al*. 2015) which could serve as mulch materials with associated soil, and water conservation functions (Jaganathan 2016) on account of reduced run off, evaporation losses (Ravi and Vivek 2001) improved soil structure and increased water infiltration (DeVetter *et al*. 2015) besides weed management (Gangaiah 2019). Based on assumption of 5 t/ha waste generation by areca nut crop, ANI has 23125 t of wastes during 2016-17. Areca nut husk is least utilized on account of lack of fibre extraction industries. while leaves are used as fuel to some extent. These residues available at the farm can be used as mulch. Further many ferns growing on the areca nut truck hampers the climbing of trees for manual harvest and oak leaf fern (*Drynaria quercifolia* (L.) J. Sm.) is one such widely growing flora in islands. Its biomass can also provide mulch material. However, residue mulching may enhance the pest (disease and insect) problems by serving as food (insect) or medium for harbouring disease inoculums. Partial ground coverage of organic mulches leading to light penetration to ground leads to growth of some weeds and thus is less effective. Moreover, clean cultivation is preferred by many farmers. Above reasons have paved the way for the use of plastic mulches. Though, residue mulching was practised since long time and plastic mulching is recommended in the islands in recent times, however, no scientific information was generated on their role in weed management and moisture and nutrient conservation. Keeping this in view, a field investigation was carried out to assess the utility of organic and inorganic (plastic) mulches on weed management and water and nutrient conservation in rain fed areca nut production system of Andaman and Nicobar Islands.

A field experiment was carried out during September, 2018 and March, 2019 at Garacharma Research Farm of ICAR-Central Island Agricultural Research Institute, Port Blair, Andaman & Nicobar Islands located at 11^0 66’ N latitude and 92^0 75’ E longitude. The experimental site soil in top 30 cm depth was found to be neutral in reaction (6.7 pH) non-saline (ECe: 0.52 dS/m) and contained 259, 11.1 and 132 kg/ha of available nitrogen (N), phosphorus (P) and potassium (K). The soil moisture holding properties (0-30 cm) indicate a field capacity (FC) and permanent wilting point (PWP) moisture of 20 and 9%, respectively and soil has a bulk density of 1.45 g/cc. The study was conducted in fully grown up areca nut plantation of 20 years age (‘*Mangala*’ variety) in sole stands planted at 2.7 x 2.7 m spacing. The experiment was laid out in randomized complete block design (RCBD) with seven treatments that are replicated five times and single tree is taken as replication. Area encircling the areca nut tree trunk on 0.75 m radius (1.77 m^2 area) was used for imposition of treatment. Seven mulching treatments with un-chopped areca nut leaves, chopped areca nut leaves, areca nut fruit husk, oak fern (*Drynaria quercifolia*) leaves, black plastic mulch of 50 µ thickness along with no mulch-no weeding and no mulch - weed free through monthly manual hoeing with pick axe were evaluated. Treatments were imposed on 12th October, 2018. Ten areca nut leaves as unchopped and chopped (5 cm); areca nut fruit husk at 5 kg/tree; un chopped oak fern leaf at 3 kg/tree; black ploythene mulch (50 µ thick) were spread around the tree trunk. The weed flora of the experimental site was recorded in 1m^2 at 15 locations that were uniformly spread over experimental field. Plot wise weed count (grasses and broad-leaved weeds *i.e.,* BLW) was recorded from 0.25 m^2 quadrates at start of treatment imposition and converted to report on m^2 basis. From weed free treatment, weeds removed along with their roots every month were collected, separated into grasses and BLW. Root portion was separated and leftover above ground biomass was oven dried at 60^0 C for 48 hours so as to attain a constant weight and was expressed as dry weight g/m^2.

Soil moisture content (SMC) was determined up to 30 cm depth (0-10 and 10-30 cm) at 20 days interval during rain free period (15 January, 14 February and 16 March, 2019) by gravimetric method (Dastane 1972). Weed control efficiency (WCE) was worked out as per Ahlawat *et al.* (2005); WCE (%) = {Weed dry weight (g) in weedy check plot - weed dry weight in treatment plot /weed dry weight in weedy check plot} x 100. As weed count and dry weight data had zero values, the data was subjected to square root transformation ($\sqrt{x+0.5}$) prior to statistical analysis. Weed biomass was analysed for nutrient (NPK) concentration as per Dhyan Singh *et* *al.* (2005) and nutrient uptake (kg/ha) of grasses, BLW and their total was estimated as product of nutrient concentration (%) and weed dry matter (kg/ha)/100. For soil moisture depletion assessment, soil samples were drawn from 0.5 m away from areca nut tree bole at two depths (0-10 and 10-30 cm) and initial weight was recorded. The same samples were oven dried for 48 hours at 60^0C to attain constant weight and was recorded as dry weight. Soil moisture content (%) was calculated as: {initial soil weight (g) –oven dry soil weight/ oven dry soil weight} x 100. Cost of cultivation was worked out taking into consideration the input prices (material and men). For cost of cultivation calculation, a price of ` 26.6/palm was used for black polythene. No cost was considered for areca nut, silver oak fern leaves and husk. For areca nut leaf mulch (un-chopped) and silver oak fern leaf; areca nut chopped leaves and areca nut husk mulching, 5, 15 and 10 man days were used. For weed free plot, a labour cost of 30 man days was used. It was arrived as product of labour used /weeding (5 man days) and number of weedings (6) at monthly interval (October-March). More labour was used in first manual weeding (digging) that got reduced in subsequent weedings. Sum of labour used in 6 weedings was used in labour estimates. As areca nut is perennial crop, its yield is continuously formed and bunches are harvested. The bunches formed after imposition of treatments are yet to come to harvest (it takes 5-6 months for bunch formation-harvest), hence, yield data has not been not reported. A rainfall of 97.3 cm (October, 2018 – 20 March 2019) was received in 42 rainy days (**Figure 1**). The mean maximum and minimum temperature ranged from 29.8-31.7 and 19.7-22.2 ^{0}C during the study period with a mean relative humidity values of 70-92%. Mean monthly evaporation of Port Blair (1987-97) was 13.87 cm (11.61 cm in November and 16.45 cm in March). The analysis of variance for RCBD was done. The significance of treatment differences was compared by critical difference at

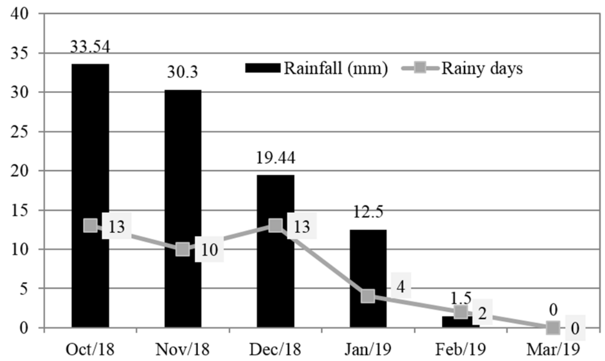

Figure 1. Monthly rainfall and rainy days at Shadipur, Port Blair weather station

5% level of significance (p=0.05) and statistical interpretation of treatments was done as per Gomez and Gomez (1984).

Experimental period have sufficient moisture up to first week of January, 2019. After, 8 January, there was meagre rainfall. During the rain free period (10 January- 12 March) recording of soil moisture was done for different treatments. Data showed that mean monthly rain fall was far behind the evaporation. Areca nut leaves fallen from tree were collected and 5 leaves were chopped in to small pieces (10 cm size) and oven dried at 60^0C for 72 hours and dry weight was recorded (g). The used leaves had an average weight of 197.5 g / leaf. Average weight of fruit husk collected from processing unit was 25 g.

Weed flora

Weed flora was recorded from no mulch (control) plot and the whole plantation area of the experiment. The weed flora of experimental field include mostly grasses, few dicots (shrubs and herbs) and 3 epiphytes (trailing on trunk). The grassy weeds were distributed as thick mat on ground and epiphytes on tree trunks; however, the BLW distribution was irregular in the experimental area and varied among treatments. *Ischaemum rugosum* Salisb.; *Eleusine indica* (L.) Gaertn.; *Oplismenus compositus* (L.) Beauv.; *Dinochloa andamanica* Kurz.; *Cynodon dactylon* (L.) Pers.; *Digitaria sanguinalis* L.(Scop.); *Themeda traindra* Forssk; *Setaria viridis* (L.) Beauv were the major grassy weed flora of the experimental site during the study period.

The dicot weeds: *Mucuna gigantea* (Willd.) DC.; *Ipomoea pes-caprae* (L.) R.Br.: *Mikania micrantha* H.B.K.; *Phyllanthus niruri* L.; *Tridax procumbense* L.; *Mimosa pudica; Ageratum conyzoides* (L.); Mill.; *Alysicarpus ovalifolius* (Schumach.) J. Leonard.; *Chromolaena odorata* (L.) King and Robins. *Clitoria ternatea* L.; *Convolvulus arvensis* L.; *Corchorus* sp; *Euphorbia geniculata* Orteg.; *Martynia annua* L.; *Cleome viscosa* L.; *Centrosema pubescens* Benth.; *Achyranthes aspera* L.; *Euphorbia hirta* L.; *Hyptis capitata* Jacq.; *Melastoma malabaricum* L. Three epiphytes: String of nickels or button orchid: *Dischidia nummalaria* R.Br*;* the Malayan urn vine *Dischidia major* (Vahl) Merr and*;* oak leaf fern: *Drynaria quercifolia* (L.) J. Sm. were recorded in the site uniformly.

Weed count, weed dry weight and weed control efficiency

Weed count recorded at the time of imposition of treatments (**Table 1**) indicate that on an average

Table 1. Weed count at start of treatments imposition and end of study under different mulches

Treatment	Weed count (no./m^2)					
	At start (12 October, 2018)			On 20 March, 2019		
	Grass	BLW	Total	Grass	BLW	Total
Areca nut leaf mulch	28.5	6.0	35.1	3.050 (8.8)	1.897 (3.1)	3.521 (11.9)
Areca nut chopped leaf mulch	29.7	6.5	36.2	2.302 (4.8)	1.673 (2.3)	2.757 (7.1)
Areca nut husk mulch	30.0	6.3	36.3	2.000 (3.5)	1.844 (2.9)	2.627 (6.4)
Silver oak leaf mulch	31.4	5.9	37.3	2.550 (6.0)	1.871 (3.0)	3.082 (9.0)
Black polythene mulch	30.7	6.7	37.4	0.707 (0.0)	0.707 (0.0)	0.707 (0.0)
Weedy check	30.8	6.4	37.2	5.648 (31.4)	2.646 (6.5)	6.197 (37.9)
Weed free check (no mulch)	31.0	7.0	38.0	0.707 (0.0)	0.707 (0.0)	0.707 (0.0)
LSD (p=0.05)	NS	NS	NS	0.384	0.151	0.250

*****Figures in parentheses are original values; Outside parenthesis data is $\sqrt{x+0.5}$ values, BLW: broad-leaved weeds

36.6 weeds (30.2 grasses and 6.4 BLW) were present in m^2 area. No significant differences in weed count among treatments showed their uniform distribution. In weed free treatment, the above ground dry weight of these weeds was recorded as 173.1 g/m^2 and of the total weed dry weight, 75.2% was of the grasses and the remaining 24.8% comprised of BLW. In the next 5 weedings (November, December, January, February and March), 25, 18, 12, 24, 7 g (86.0 g/m^2 total) of above ground weed biomass was produced. Weed biomass decreased substantially as weeds were removed along with their roots. Few weed roots left in soil and weed seed germinations have contributed to new weed biomass that varied from the highest of 25 g (November) to the lowest of 7 g (March). During February, there was higher biomass than January on account of rains (4-7 January) with that many new weeds have germinated. Weed count recorded on 12 March, 2019 (**Table 2**) showed 0 (zero) values in both weed free check and black polythene mulch treatments. Elimination of weeds by polythene mulching and their physical removal in weed free treatment were the reasons for the zero weed counts. Weedy check had the highest total weed count values (37.9). It showed that there was slight increase in weed count during the experimental period (6 months) over that recorded at the start of study in October. With drying of weeds and receipt of rains, few new weeds have germinated, hence slight increases in weed count was observed. Weed count differed among mulch treatments significantly and their effect varied with grasses and BLW. Silver oak leaf mulch applied treatment had more BLW while areca nut leaf mulch more grasses.

Table 2. Weed biomass (g/m^2) at end of study under different mulches

Treatment	Weed biomass (g/m^2) on 20 March, 2019		
	Grass	BLW	Total
Areca nut leaf mulch	6.74 (45)	5.46 (29)	8.65 (74)
Areca nut chopped leaf mulch	4.63 (21)	4.38 (19)	6.33 (40)
Areca nut husk mulch	3.43 (11)	5.07 (25)	6.08 (36)
Silver oak leaf mulch	5.70 (32)	5.56 (28)	7.93 (60)
Black polythene mulch	0.71 (0)	0.71 (0)	0.71 (0)
Weedy check	16.30 (265)	8.21 (67)	18.24 (332)
Weed free check (no mulch)	0.71 (0)	0.71 (0)	0.71 (0)
LSD (p=0.05)	1.01	0.58	0.81

Weed biomass (g/m^2) at start of experiment in weed free check: 130.1-43.0-173.1 g for grass, BLW and total

Weed dry weight following the weed count differed significantly among treatments (**Table 2**). Weedy check had 332.2 g/m^2 weed biomass as on 12 March, 2019 and of this 79.9% was of grasses. Areca nut leaf mulch followed silver oak leaf mulch had higher weed biomass than chopped leaf mulch and husk mulch. There was no weed biomass in weed free and black polythene mulch. Weed control efficiency (based on weed biomass) presented in **Table 3** showed significant differences among weed management through mulching and varied from 81.22 to 100%. On account of no weed biomass in polythene and weed free treatments, WCE was 100%. Under polythene (black) mulching, weeds started showing yellowing symptoms within 3 weeks time and in next 3 weeks wilted (white to brown stage) completely. Areca nut chopped leaf mulch had WCE values at par of areca nut husk mulch, though for BLW, former was found significantly more effective to the later. Organic mulches were found effective in grassy weed management (89.0% WCE) than BLW (62% WCE). Overall silver oak and areca nut leaf mulches proved least effective based on WCE. However, silver oak leaf

Table 3. Weed control efficiency (%) as influenced by mulching practices

Treatment	Weed control efficiency (%)		
	Grass	BLW	Total
Areca nut leaf mulch	80.04	56.20	77.63
Areca nut chopped leaf mulch	92.12	72.05	92.93
Areca nut husk mulch	95.74	62.33	89.01
Silver oak leaf mulch	87.94	57.55	81.82
Black polythene mulch	100.0	100.0	100.0
Weedy check	0.0	0.0	0.0
Weed free check (no mulch)	100.0	100.0	100.0
LSD (p=0.05)	5.08	7.23	6.51

mulching was significantly more effective than areca nut leaf mulch (unchopped) for grassy weed management due to better cover of ground. Grassy weeds started growing from vacant spaces of areca nut leaves. The wilted weeds gradually decomposed and acted as manure in 12 weeks period. Complete (100%) exclusion of light under black plastic mulch has arrested the photosynthesis of weeds while respiration continued that resulted in yellowing of leaves and finally their death. Low reflectance of light under black mulch (~5%) in tomato (Fortnum *et al.* 2000) supports the complete light absorption contention of this study. A complete (100%) weed management attained in the current study are also supported by the findings of Gangaiah (2019) with transplanted and direct-seeded rice grown under plastic film mulches.

On account of ineffective ground coverage under organic mulches, light continue to reach the ground and to weeds and their growth/ photosynthesis continued. Chopping up of leaves reduced the light penetration to the ground as compared to unchopped areca nut leaf mulch and areca nut husk mulch also has reduced light penetration to the ground. The differences in light penetration to the ground, weed count, biomass and finally WCE differed among mulches. Under unchopped leaf mulches (areca nut and silver oak leaves), few of the weeds emerged out of mulches and continued their growth. Thus unchopped leaf mulch remained less effective than chopped mulches (leaf and husk). Differential reflectance of light by mulches (aluminium foil > oak leaf mulch >no mulch) reported by Setiawan and Ragsdale (1987) in carrot explains the differential performance of mulches in the current study.

Nutrient removal

The nutrient removal/ha of plantation *i.e.* 1.767 m^2 area of treatment/plant x 1372 plants/ha (2424.3 m^2) by weeds was huge. Weeds in their above ground biomass (6 weedings: 259.1 g/m^2) in weed free treatment contained 33.7- 5.18-38.9 kg/ha of N-P-K. If treatment area of palm is only considered (including bole area of 100 m^2), 24.24% of the above nutrients were removed from tree zone. Nutrient removal would be still higher if root biomass is also accounted (here not considered). Most of this nutrient uptake came from first weeding on account of its high share in total biomass (66.8%). It has been observed that weed biomass produced after first weeding had higher concentration of nutrients than first observation on account of their younger age at removal (30 days). In weedy check, the weed biomass (332.2 g/m^2) recorded on 12th March *i.e.*, a mix of matured and drying grasses and BLW and few newly germinated weeds. Though, it had less nutrient concentration than weed free treatment on account of aging (maturity), but caused higher nutrient removal (38.2-5.7-46.5 kg/ha N-P-K) owing to 28.2% higher biomass. In mulched treatments, the nutrients contained in unremoved weeds (weed free treatment biomass in first weeding is indicator) were controlled and depending on control efficiency got converted into organic manure or retained on the surface as dead / stunted mass. In black plastic mulch treatment, 100% weeds got killed and their biomass was added to soil and is under decomposition since November, 2018.

Moisture conservation

Soil moisture content (%) at two soil depths (0-10 and 10-30 cm) representing weed and weed + crop root soil moisture extracting zones as influenced by mulching practices are presented in **Table 4**. On account of heavy rains (4-7 January, 2019 from Pabuk cyclone), soil moisture was near saturation in January observation in all treatments at both depths and was uniform. It did not vary among treatments at both depths in 15 January, 2019 observation. At

Table 4. Soil moisture content (%) at 0-10 and 10-30 cm soil depths at monthly intervals as influenced mulching and other weed management practices

Treatment	Soil moisture content (%)					
	15 January		14 February		16 March	
	0-10 cm	10-30 cm	0-10 cm	10-30 cm	0-10 cm	10-30 cm
Areca nut leaf mulch (unchopped)	17.4	19.1	12.6	15.5	11.5	13.5
Areca nut leaf mulch (chopped)	17.8	19.0	13.3	16.1	11.8	13.7
Areca nut husk mulch	17.6	19.0	13.2	15.9	12.0	13.9
Silver oak leaf mulch	17.3	18.8	12.9	15.7	11.6	13.7
Black polythene mulch	17.9	19.2	14.0	16.2	12.8	14.1
Weedy check	16.8	18.7	11.5	15.2	09.6	12.7
Weed free check (no mulch)	17.2	19.0	12.3	15.9	10.3	13.0
LSD (p=0.05)	NS	NS	0.94	NS	0.98	NS

subsequent two observations, SMC differed significantly in 0-10 cm depth only. Weedy check plot has lost moisture rapidly between 15 January - 16 March and reached PWP level. Weed free check (no mulch), has second lowest SMC. In March observations, all mulched treatments have significantly higher SMC than weed free and weedy check. Polythene mulched plots recorded highest SMC values, though were at par with other mulched treatments.

In weed free plot, evaporation (E) from the bare soil (top 10 cm) was the only form of water loss besides crop uptake (common to all treatments) at deeper layers. Evaporation got decreased over time on account of source limitation (decreased soil moisture supplies in top layer). It was devoid of any weeds on account of monthly weeding. Thus SMC decreased to PWP in two months in 0-10 cm. In weedy check plots, evapo-transpiration (ET) losses of weeds depleted the soil moisture. ET losses of weedy plots were higher than the E loss from weed free plot. Thus, weed free plots had slightly higher SMC than weedy check. Both these plots were near PWP indicating stress build up for crop. Mulches reduced ET losses of water by way of reducing weed counts and their biomass on one hand and by acting as a physical barrier between atmosphere and soil on other hand has prevented the solar radiation to evaporate water freely. Plastic mulches have completely excluded the water loss from ET by controlling weeds and covering the soil. Residue mulches though controlled the weed menace, but could not effectively cover the soil and E continued due to partial cover of the soil. In deeper layer of soil (10-30 depth), SMC did not differ significantly among the mulched and un-mulched treatments though weedy check had lower values as compared to others. In the current study, most of the weed flora comprised of grasses which roots are confined to the top 5 cm only (BLW and some grasses have roots at deeper layers up to 15 cm) and thus did not impact 10-30 cm depth moisture level much. At this depth, crop uptake was major form of water uptake/loss. Thus all treatments were statistically at par. However, the moisture supplies to top layer for evaporation and uptake by weeds (in proportionate to weed count & and weed biomass) have contributed to lower soil moisture in unmulched and organic residue mulched treatments than plastic mulched ones. Earlier studies indicated higher ET losses in un-mulched (4.96 mm/ day) than areca nut husk (4.40 mm/day) and polythene mulched (3.79 mm/day) treatments in areca nut crop (Abdul Khader and Havaangi 1991). The lower SMC of the current study among mulched and un-mulched treatments were corroborated by the above findings.

Cost of treatments

Costs of various mulching treatments were given in **Table 5**. The data reveals that areca nut leaf mulching (un-chopped) was cheapest (` 2300/ha) while polythene mulch was the costliest (` 41095/ha) treatment. Plastic mulch cost was 17.9 times that of un-chopped leaf mulch. When a life span of 5 years is taken for plastic mulch, it becomes cheaper than weed free treatment in which every year weeding cost was incurred. Organic mulches have advantage of becoming manure over time and contributing to crop nutrition. The residues generated from crop on adding regularly may decompose over time and adds to the organic matter of soil, which increases soil water holding capacity and also nutrient supplies to crop from mineralized residues.

Crop performance

In perennial crop, yield recording and relating it to weed/mulch treatments requires longer period of study. In the current study, one harvest was done and did not show any significant differences (with an average bunch weight of 6 kg). This is because, these harvested bunches were formed before the initiation of study and the bunches formed during study period are yet to be harvested. Study will continue further to record the productivity and conversion of organic wastes into manure.

Table 5. Cost of mulching and other weed management practices

Treatment	Cost of mulching (`/ha)		
	Cost of materials	Cost of labour	Total
Areca nut leaf mulch (unchopped)	-	2300	2300
Areca nut leaf mulch (chopped)	-	4600	4600
Areca nut husk mulch	-	4600	4600
Silver oak leaf mulch (includes collection from tree trunk)	-	4600	4600
Black polythene mulch at ` 26.6/palm) + labour	36495	4600	41095
Weedy check (no mulch and no weeding)	-	-	-
Weed free check (no mulch, weed free): 30 man days at 460/day)	-	13800	13800

Only labour cost taken for organic mulches and weed free situation

Conclusion and future line of work

Weeds are a severe menace in plantation crops in Islands that were controlled effectively by black polythene mulch during the rain free period where soil moisture becomes limiting (January-March). However, organic mulches would be ideal, though have lower efficiency with single application. When continuously applied over years, they are likely to become more effective. There is need to do more studies over years to record the impact on yield and to workout economics.

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