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Mulching Effect on Growth Attributes in Onion

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Abstract

Effect of rice husk, sawdust, ash and burnt soils as mulches on the growth attributes of onion was studied. Significant variations were observed in plant height, root length, total dry matter accumulation, leaf area index (LAI), crop growth rate (CGR) and net assimilation rate (NAR), whereas relative growth rate (RGR) was found nonsignificant in all stages of growth. Root: shoot ratio was significantly different at the early stages of growth (30 to 60 DAT) and thereafter it was found nonsignificant. All the mulches had positive effect on growth attributes over the control and the use of ash as mulch was found better compared to the other three.

Introduction

Onion (*Alllum cepa* L.) ranks first among the spice grown in Bangladesh, in production (Anonymous, 1997a), but the average yield was quite low (4.12 t ha^{-1}) compared to that of most other countries (Anonymous, 1997b). Onion is grown in Bangladesh in winter season when short day length and low temperature prevails which are not conducive to produce big size bulbs. Thus more improved variety does not bring about significant yield improvement in onion. So, to minimize the cultivation and production problems emphasis must be given to adopt improved cultural practices. Among different cultural practices mulching has some promising effects on the onion production. Mulching materials with different spectral properties are reported to increase soil temperature and thus enhancing bulb development (Suh *et al*., 1991; Barkley *et al*., 1965). Moisture is an important factor that influences the growth attributes of onion. Mulch reduces the water loss by evaporation resulting in more conservation of moisture in soil (Prihar, 1986). Artificial mulching like polythene are reported to increase the growth and yield of onion (Greisenheim, 1952). But research works on onion with indigenous mulching materials like rice husk, sawdust, ash and burnt soils are quite meagre in Bangladesh as well as in the world. Hence, keeping in view the above facts this piece of research work was thus undertaken to study the effect of indigenous cheaply available mulching materials on growth attributes of onion.

Materials and Methods

The experiment was carried out at the Field Laboratory of the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, during the rabi season (December, 1995 to April, 1996) with :four mulches viz, rice husk, sawdust, ash and burnt soil each at the rate of 10 t ha^{-1} on onion (cv. Faridpuri Briati). The experiment was `laid out in Randomized Complete Block Design (RCBD) with four replications. The unit plot size was 5 m x 2 m. The soil belonged to the Old Brahmaputra alluvial tract having sandy ;oam in texture. The plots were fertilized with cowdung, urea, triple super phosphate (TSP) and muriate of potash (MP) at of 10 t ha^{-1}, 175 kg ha^{-1}, 125 kg ha^{-1} and 150 kg ha^{-1}, respectively. The whole amount of cowdung and TSP and the 50 percent of urea and MP were applied during final land preparation. The rest 50 percent of urea and MP were applied as top dress at 25 days after transplanting (DAT). About 50 days old seedlings of uniform size were transplanted on 5th January, 1996 in a single row system with 20 cm x 15 cm spacing. The mulches were sprayed over the plots on 29 DAT. Intercultural operations were done as and when necessary.

The first crop sampling was made at 30 DAT and continued at 10 days intervals till physiological maturity at 90 DAT. Prior to harvesting plants m^{-2} were counted followed by measuring the height of the individual plant by a graduated scale placed from ground level to top of the plant. At the time of each harvest the plant m^{-2} area were uprooted carefully by a 'khurpil' in order to ensure maximum root extraction and carried to the laboratory in polythene bags to prevent transpiration. After cleaning the harvests the root length of each plant of the harvested area (Im^2) was measured by graduated scale. The component parts representing root, stem (including bulb) and leaf were separated. Leaf area was measured by an automatic leaf area meter (Model, L1-3000). Then the components were oven dried for 48 hours at 80°C and their corresponding dry weights were determined by a sensitive balance. Different growth estimates such as CGR, RGR and NAR were made following the formulae rendered by Hunt (1978). Data on plant parameters and microclimatic parameters were analyzed statistically and their mean differences were adjusted as per DMRT or LSD.

Results and Discussion

Plant height: Mulching induced significant variation in plant height of onion (Table 1). Maximum plant height (45.38 cm) was recorded in plants mulched with sawdust while control had the least (39.02 cm). The maximum plant height as recorded on 90 DAT under rice husk, ash and burnt soils were 42.98, 42.56 and 39.74 cm, respectively, The increase in plant heights due to various mulches had been reported for onion (Suh *et al*., 1991). The. increased plant heights due to mulching effects might have resulted

Table 1: Effect of different mulches on the plant height and root length of onion

Treatments	Plant height (cm) at different DAT*					Root length (cm) at different DAT*				
	50	60	70	80	90	50	60	70	80	90
Rice husk	33.76a	38.18bc	41.80ab	42.47ab	42.98ab	6.74bc	7.75	8.78b	9.25b	.9,44b
Saw dust	32.26ab	39.41ab	44.56a	44.94a	45.38a	6.56c	7.59b	8.88b	9.40b	9.59b
Ash	34.35a	40.85a	41.87ab	42.11ab	42.56ab	7.02a	8.30a	9.78a	10.4a	10.69a
Burnt'soil	33.20ab	37.49bc	38.90bc	39.36bc	39.74bc	6.78abc	7.75b	8.97b	9.47b	9.61b
Control	30.15b	36.60c	37.92c	38.61c	39.02c	6.87ab	7.88b	9.14b	9.695	9.79b
LSD' 0.01	3.209	2.299	3.127	3.073	3.254	0.264	0.398	0.487	0.515	0.501

*DAT indicates days after transplating; Means having similar letter(s) in a column do not differ significantly at 1 % level of probability

Table 2: Effect of different mulches on the toital dry matter accumulation of onion

Treatments	Total dry matter accumulation at different DAT**						
	30	40	50	60	70	80	90
Rice husk	8.64ab	15.00b	25.92bc	62.16c	102.2b	132.2c	164.9c
Saw dust	8.85a	15.40ab	26.60b	64.405	106.0a	140.55	171.0b
Ash	9.13a	15.80a	29.04b	67.20a	108.5a	151.2a	181.8a
Burnt soil	8.21b	14.20c	25.73bc	59.32d	100.4b	130.0c	160.3c
Control	8.24b	14.05c	25.20c	56.98e	98.6b	126.4d	153.8d
LSD 0.01	0.4971	0.515	1.095	1.495	3.455	2.830	5.433

*DAT indicates days after transplating. Means having similar letter(s) in a column do not differ significantly at 1 % level of probability

Table 3: Effect of different mulches on the root shoot ratio of onion

Treatments	Root shoot ratio at different DAT*						
	30	40	50	60	70	80	90
Rice husk	0.28c	0.20c	0.15a	0.06a	0.04a	0.013	0.01a
Saw dust	0.25d	0.18d	0.13b	0.05a	0.03a	0.01a	0.01a
Ash	0.32a	0.23a	0.17a	0.07a	0.04a	0.02a	0.01a
Burnt soil	0.31b	0.22b	0.16a	0.07a	0.03a	0.02a	0.01a
Control	0.32a	0.23a	0.17a	0.07a	0.03a	0.02a	0.01a
LSD 0.01	0.0068-	0.0068	0.0216	ns	ns	ns	ns

*DAT indicates days after transplating. Means having similar letter(s) in a column do not differ significantly at 1 % level of probability

from retention of more soil moisture in association with lower soil temperature throughout the growth period whereas the control plants deprived of aforesaid benefits.

Rootlength: Root length with ash mulch was significantly higher than control throughout the whole growth period and the root length with rest of the mulches were not significantly different from each other except the growth stage of 50 DAT (Table 1). The irfcreasing root length under ash mulch corrjpared to control might have resulted from low soil moisture content and high soil temperature. The reduced root lengths in all other mulches might have resulted from the retention of high soil moisture and low soil temperature.

Total dry matter accumulation: Dry matter accumulation was significantly higher for mulched plots compared to the control (Table 2). The highest DM (181.84 g m^{-2}) was recorded from the plants with ash mulch while control had the lowest (153.81 g m^{-2}). The plant DM of ash mulch was greater than that of sawdust (171.01 g m^{-2}) followed by rice husk (164,92 g m^{-2}) and burnt soil (160.36 g m 21. Increase in DM production depends on the photosynthetic efficiency (source), sink strength and translocation capacity of crops (Evans, 1975). The increasing Lals with their greater photosynthetic ability resulted in increased dry matter accumulation (Pandey, 1980; Watson, 1947).

Root shoot ratio: The effect of mulches were statistically significant during the early growth stages (30-50 DAT) and

Table 4: Effect of different mulch on Leaf Area Index (LAI) and Crop Growth Rate (CGR) of onion at different dates after transplanting

Treatments	LAI (x 10^{-2})						CGR (g m^{-2} day^{-1})					
	40 DAT	50 DAT	60 DAT	70 DAT	80 DAT	90 DAT	40 DAT	50 DAT	60 DAT	70 DAT	80 DAT	90 DAT
Rice husk)	15.6b	35.48c	59.46c	86.72b	61.68a	48.06b	0.53c	1.09b	3.62b	4.00a	3.00c	3.28a
Saw dust	15.5b	37.0b	60.86b	87.62a	62.16a	50.03a	0.65b	1.12b	3.78ab	4.16a	3.44b	3.05a
Ash	16.74a	38.53a	64.06a	71.08c	57.24b	44.42d	0.66a	1.32a	3.82a	4.13a	4.27a	3.06a
Burnt soil	14.88c	33.7d	53.15d	67.55d	54.02c	47.22c	0.60d	1.15b	3.36c	4.11a	2.96c	3.03a
Control	14.50c	32.88e	52.35e	67.22d	52.03d	47.25c	0.58e	1.12b	3.18d	4.00a	2.79c	2.74a
$LSD_{0.01}$	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0068	0.0683	0.1673	ns	0.3614	0.5202

In a column figures followed by no common letter(s) are significantly different at 1 % level. DAT = Days After Transplanting

Table 5: Effect of different mulch on Relative Growth Rate (RGR) and Net Assimilation Rate (NAR) of onion at different dates after transplanting

Treatments	RGR x 10^{-2} (g g^{-1} d^{-1})						NAR					
	40 DAT	50 DAT	60 DAT	70 DAT	80 DAT	90 DAT	40 DAT	50 DAT.	60 DAT	70 DAT	80 DAT	90 DAT
Rice husk	2.39a	2.32a	3.79a	2.15a	1.11a	0.95a	0.56ab	1.95b	3.38a	2.40c	1.77c	2.60a
Saw dust	2.40a	2.37a	3.83a	2.16a	1.21a	0.85a	2.65a	1.96b	3.41 a	2.45c	2.01be	3.37a
Ash	2.38a	2.63a	3.63a	2.07a	1.43a	0.79a	2.52h	2.19a	3.29a	2.65bc	2.85a	2.62a
Burnt soil	2.38a	2.57a	3.62a	2.28a	1.11 a	0,90a	2.54ab	2.17a	3.41a	2.96a	2.12b	2.59a
Control	2.31a	2.51a	3.53a	2.37a	1.07a	0.84a	2.53ab	2.15a	3.29a	2.92ab	2.03bc	2.39a
$LSD_{0.01}$	NS	NS	NS	NS	NS	NS	0.1183	0.1527	0.1673	0.2816	0.3204	0.3929

In a column figures followed by no common letter(s) are significantly different at 1 °/0 level. DAT -- = Days After Transplanting

thereafter it was insignificant (Table 3). The unmulched plants had the maximum root shoot ratio while sawdust had the least. At the vegetative stage, more photosynthates were diverted to produce a sound root mass but with the transition of bulbing most of the photosynthates were consumed by the developing bulbs. The resultant effect was a decrease in the root shoot ratio.

Leaf area index (LAI): Mulching significantly increased LAI at all stages of growth. After establishment of the transplants the LAI sharply increased from a lower value of about 0.1 at 30 DAT to around 0.9 at 70 DAT. After attaining the maximum the LAI sharply declined with the approach of maturity. The highest LAI (nearly 0.88) was, however, observed in plants mulched with sawdust and the lowest (0.67) in the control (Table 4). Mulches in potato increased LAI significantly at different stages of growth (Roy *et al*., 1990).

Crop growth rate (CGR): All mulches significantly influenced SGR at all stages of development except 70 DAT and at final harvest on 90 DAT. Except ash CGR values in all mulches attained their peak at 70 DAT while in ash it had the maximum at 80 DAT. Plants grown under ash attained highest CGR (4.27 g m^{-2} d^{-1}) followed by sawdust (4.16 g m^{-2} d^{-1}) and burnt soil (4.11 g m^{-2} d^{-1}). The CGR in control and rick husk was almost identical (Table 4).

CGR in onion decreased during 31-45 DAT, after which it increased gradually upto 75 DAT and then decreased gradually (Rao, 1988). CGR is positively correlated with LAI (Watson, 1947). Thus CGR increased with the increase in LAIs (Table 4) in all the treatments and the lower values of CGR at the initial stages of growth was the result of lower LAIs.

Relative growth rate (RGR): Mulching increased RGR in most stages of growth but the values were statistically insignificant (Table 5). The increase in RGR in potato was also insignificant (Roy *et al*., 1990). The maximum RGR at 60 DAT correspondent to the rapidly developing bulbs. The decline in RGR after reaching the maxima was due to leaf abscission and crop age (Pandey *et al*., 1978; Katiyar, 1980).

Net assimilation rate (NAR): NAR values were statistically significant at all stages of growth except 60 and 90 DAT. There was a high increment of NAR at 40 DAT followed by a lag period around 50 DAT and thereafter, it attained maximum at 60 DAT. After attaining the maximum, a gradual decrease was apparent till 80 DAT (Table 5). NAR had higher values during the early vegetative growth but declined with age in chickpea (Haloi and Baldev, 1986) and this was possibly due to mutual leaf shading and increased number of old leaves (Pandey *et al*., 1978). The maximum values of NAR at 60 DAT were related to the rapidly developing sinks (Haloi and Baldev, 1986).

Considering the different growth parameters in relation to changing soil environment, mulching practice showed better performances than the control. All the mulches are readily available at cheaper rates under the socio-economic conditions of Bangladesh and these mulches are recommended in onion cultivation. The use of ash as mulch was found better compared to the other three.

References

Anonymous, 1997a. FAO Production Yearbook, 1997. Vol. 51, Food and Agriculture Organization of the United Nations, Rome, pp: 58.

Anonymous, 1997b. Statistical Yearbook of Bangladesh. Bangladesh Bureau of Statistics, Dhaka, Bangladesh, Pages: 139.

Barkley, D.G., R.E. Blaser and R.E. Schmidt, 1965. Effect of mulches on microclimate and turf establishment. Agron. J., 57: 189-192.

Evans, L.T., 1975. The Physiological Basis of Crop Yield. In: Crop Physiology Some Case Histories, Evans, L.T. (Ed.). Cambridge University Press, Cambridge, UK., pp: 327-355.

Greisenheim, A.M., 1952. Mulching trials with tomatoes, cucumbers, onion, carrots and dwarf beans. Beg. Lehr. U. Forsch. Anst. Geisenhaim Rhim, pp: 37.

Haloi, B. and B. Baldev, 1986. Effect of irrigation on growth attributes in chickpea when grown under different dates of sowing and population pressure. Indian J. Plant Physiol., 29: 14-27.

Hunt, R., 1978. Plant Growth Analysis. Edward Arnold Ltd., London, UK., ISBN-13: 978-0713126969, Pages: 67.

Katiyar, R.P., 1980. Developmental changes in leaf area index and other growth parameters in chickpea. Indian J. Agric. Sci., 50: 684-691.

Pandey, R.K., 1980. Physiology of seed yield in lentil: Growth and dry matter production. Legume Res., 3: 7-11.

Pandey, R.K., M.C. Saxena and V.B. Singh, 1978. Growth analysis of blackgram genotypes. Indian J. Agric. Sci., 48: 466-473.

Prihar, S.S., 1986. Fertilizer and water use efficiency in relation to mulching. Indian J. Agron., 32: 452-454.

Rao, N.K.S., 1988. Physiological analysis of growth and yield in onion (*Allium cepa*). Indian J. Agric. Sci., 58: 489-491.

Roy, A.K., A.A.A. Muhsi and A.H. Khan, 1990. Effect of different mulches on the growth of potato. Bangladesh J. Bot., 19: 41-46.

Suh, J.K., Y.B. Kim, Y.S. Lee, K.S. Lee and K.Y. Ham, 1991. A study on the improvement of the mulching cultivation method for onions (*Allium repa* L.). Res. Rep. Rural Dev. Admin. Hortic., 33: 21-28.

Watson, D.J., 1947. Comparative physiological studies on the growth of field crops. II. The effect of varying nutrient supply on the net assimilation rate and leaf area. Ann. Bot., 11: 375-407.