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Influence of nitrogen level and planting time on growth of *Aloe vera* plant

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Abstract

An experiment was carried out at newly developmental farm (horticulture section) situated at University of Agriculture, Peshawar during the year 2012 to see whether the influence of nitrogen level and planting time on growth of *Aloe vera* plant was or not. The experiment was carried out using Randomized Complete Block Design with split plot arrangement. There were four levels of nitrogen (0, 50, 100 and 150 Kg ha^{-1}) and four planting times (20th March, 04th April, 20th April and 04th May, 2012). The Urea (46% nitrogen) was applied as a source of nitrogen. Nitrogen levels significantly affected all of the parameters except survival percentage while planting time affected all parameters significantly. The tallest plant height (32cm), highest amount of gel $leaf^{-1}$ (21.75 gm), highest leaf breadth (3.83cm),highest leaf thickness (1.67cm), High number of suckers $plant^{-1}$ (9.83), highest leaf volume (34.77 cm^3), highest number of leaves (7), heavier leaf weight (32.08 gm) were observed in suckers treated with 150 kg nitrogen ha^{-1}. While Survival percentage was not significantly affected by nitrogen. However, planting time significantly affected all parameters. Maximum plant height (27.7cm), high amount of gel $leaf^{-1}$(13.8 gm), highest leaf breadth (2.98cm),highest leaf thickness (1.67cm), highest number of suckers $plant^{-1}$ (9.17), highest leaf volume (37.04cm^3) highest number of leaves (6),heavier leaf weight (31.32 gm), survival percentage (100 %) were observed in suckers transplanted on 20th March. Nitrogen level at 150 kg ha^{-1} and 20th March as transplantation resulted best performance and hence recommended for establishment and growth of *Aloe vera* plant.

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Introduction

Aloe Vera botanically called *Aloe barbadensis* Miller belongs to Liliaceae family. There are more than 300 species of aloe. However, there are only two species grown commercially, *Aloe barbadensis* Miller and *Aloe aborescens* (Tawaraya *et al.,* 2007). Aloe Vera is a shrubby, xerophytic, perennial and succulent plant. The leaves of Aloe Vera are fleshy and have spikes along the edges and is up to 20 inches long, 5 inches wide and triangular (Schulz *et al.,* 1997). Aloe Vera has the ability to close its stomata completely to avoid loss of water therefore it is grouped in the large class of plants known as xeroids (Hect, 1981). Aloe Vera can live up to 25 years and production of Aloe Vera is done mainly through suckers (Akinyele *et al.,* 1987).

Aloe Vera is used as ornamental plant in gardens, homes and yards (Sofowara, 1984). Aloe Vera is considered as an important medicinal plant in many countries (Hasanuzzaman *et al*., 2008). The large parenchyma tic cells of the leaf contain yellow latex and clear gel which are the two major liquid sources of Aloe Vera. Products obtained from Aloe Vera are used for healing wounds, burns and minor cuts. Aloe Vera gel is used in a variety of cosmetics including shampoos, sun blocks, lotions and skin creams (Dagne *et al.,* 2000).

As a matter of fact nitrogen contributes to the vegetative growth in all plants. It is worth mentioning that in Aloe Vera the vegetative growth is the most important factor as far as quantity and quality is concerned. Both of these contribute a lot to the medicinal and cosmetics values of the product of Aloe Vera plant. It is concluded in the past that the nitrogen play a key role in quality products. (Saha *et al*., 2005; Norman *et al*., 2011; Hazrati *et al*., 2012).

Besides, planting time affect the yield as when we transplant the plants in June-July the plant is ready to give the yield in march next year and thus after the shock of frost from that the plants went through, the production decreases because Aloe Vera is highly frost sensitive and cannot tolerate the frost. Hence the planting time is another production factor that affects the growth and yield of *Aloe vera*.

Thus due to the importance of nitrogen and planting time the present experiment was planned. The objective of this study was to determine the effects of different levels of nitrogen and planting time on the establishment and growth of Aloe Vera plant.

Materials and methods

An experiment "Influence of Nitrogen Level and Planting Time on growth of Aloe Vera Plant" was performed at Newly Developed Farm (NDF) Horticulture section, The University of Agriculture, Peshawar during 2011-12.

The suckers for Aloe Vera plant were brought from Agricultural Research Institute Tarnab Peshawar. Urea was used as a source for nitrogen. Nitrogen was applied in split doses. First dose was applied 15 days after plantation of suckers whereas second dose was given 10 days after first dose.

The experiment was carried out using Randomized Complete Block Design with split plot arrangement. Experiment was replicated three times. Levels of nitrogen were assigned to main plots while planting time was kept in the sub-plots.

The details of the experiment are as follow.

Nirogen Levels	Planting Time
N_0 = control	PT_1 = 20th March
N_1 = 50 kg N ha^{-1}	PT_2 = 04rth April
N_2 = 100 kg N ha^{-1}	PT3 = 20th April
N_3 = 150 kg N ha^{-1}	PT4 = 04rth May

There were sixteen treatments in each replication including control. The experimental field was divided in 48 plots having a size of 5×6 m^2. There were 04 rows in each plot and 05 plants were planted in each row. Plant to plant distance was 30 cm and row to row distance was kept 60 cm in all plots.

Soil analysis

The composite soil samples, taken before transplanting, were analyzed for EC, pH, Organic Matter and Total Nitrogen and its analysis is given in table 1.

Table 1. Soil analysis of experimental field.

Serial#	Property	unit	Value
1	Organic matter	%	0.79
2	pH (1:5)	...	7.8
3	EC (1:5) d S/m	...	0.15
4	Total Nitrogen	mg kg-1	0.08
5	AB-DTPA ext. P	mg kg-1	5.75

Total nitrogen

Total N in soil and plant samples was determined by Kjeldahl method of Bremner (1996). Soil or plant sample of 0.2 g was digested with 3 mL of conc. H_2SO_4 in presence of 1.1 g digestion mixture containing K_2SO_4, $CuSO_4$ and Se in 100:10:1 ratio. After cooling, the digest was distilled with 20 mL of 40% NaOH into 5 mL boric acid mixed indicator solution. The distillate was titrated against 0.005 M HCl.

Total Nitrogen (%) =

$$\frac{(ml-blank) \times 0.005 \times 0.014 \times 100 \times 100}{g\ weight\ of\ plant\ or\ soil\ sample \times 20}$$

Parameters

The data regarding growth and yield components of Aloe Vera was recorded accordingly.

Number of leaves

Numbers of leaves plant^{-1} were counted by taking five plants randomly, and their average was calculated.

Plant height (cm)

Plant height was measured through measuring tape from base to the terminal tip of the plant.

Leaf thickness (cm)

Leaf thickness was measured with the help of vernier calliper by taking leaves randomly from five plants and average was calculated from it.

Leaf Breadth (cm)

Leaf breadth was measured with the help of measuring scale by taking leaves randomly from five plants and their average was calculated.

Leaf Volume (cm^3)

Leaf volume was calculated using the leaf length (L), leaf breadth (B) and leaf thickness (T) (Hernandez-Cruz *et al.,* 2002) as are bellowed:

V = (L/12) 3.14 BT.

Number of sucker's plant^{-1}

Numbers of sucker's plant^{-1} was calculated from randomly five plants, and average was calculated.

Plant Survival Percentage

Survival Percentage of suckers was worked out with the help of the following formula.

Plant Survival % age =

$$\frac{Total\ number\ of\ survived\ suckers \times 100}{total\ number\ of\ sprouted\ sucker}$$

Leaf weight (gm)

The Aloe Vera leaves were collected by randomly five plants and their average weight was calculated.

Amount of Gel leaf^{-1} (gm)

The Aloe Vera leaves were collected randomly five plants from each treatment. Their gel weight was noted with the help of electrical balance, and their average was calculated.

Method for extraction of Gel

The Aloe Vera leaves were cut at the base and cleaned with clean water, and then split diagonally into two parts. The aloe gel was then scooped using a knife into a beaker. Aloe Vera gives colorless gel (Kathuli *et al.,* 2009).

Statistical procedure

The data collected on different parameters was subjected to analysis of variance (ANOVA) technology to observe the difference, between different treatments as well as their interactions. In case where the difference was significant the mean was further assist for differences through least significant difference (LSD) test. Statistical computer software, MSTATC (Michigan state university, USA), was applied for computing both ANOVA and LSD.(Steel and Torrie, 1997)

Results and discussion

Number of leaves

The data noted for number of leaves plant^{-1} is described in table 2. Analysis of variance revealed that nitrogen levels, planting time and their interaction significantly affected number of leaves plant^{-1}. Means for planting time showed that the highest number of leaves plant^{-1} (6) was observed in the plants whose suckers were planted on 20th March.

Followed by plants whose suckers were planted on 04rth April (5) while the lowest number of leaves plant^{-1} (4) was observed in the plants whose suckers were planted on 04rth May.

Similarly means regarding nitrogen levels revealed that the highest number of leaves plant^{-1} (6) was noted in the plants when nitrogen was applied at 150 kg ha^{-1} followed by (5) in the plants treated with 100 kg nitrogen ha^{-1} while the lowest number of leaves plant^{-1} (4) was noted in plants without nitrogen.

The interaction between planting time and nitrogen showed that the highest number of leaves plant^{-1} (7) was observed in the plants whose suckers were planted on 20th March and treated with 150 kg nitrogen ha^{-1} while the lowest number of leaves plant^{-1} (3) was observed in the plants whose suckers were planted on 04rth May and applied with no nitrogen.

Suckers planted in March were established in the soil till April. The growth parameters started to increase rapidly in this month due to highest rate of metabolism and thus the best results were obtained from plants planted in March.

A similar observation has been reported by Soad *et al.,* (2001). Nitrogen is the basic content of chlorophyll. Highest level of nitrogen enhanced chlorophyll content of the plants.

As the rate of photosynthesis mainly depend on chlorophyll so these maximum chlorophyll contents produced an increased amount of photosynthate, which provide the plant with sufficient energy for cell division and tissue formation and hence more leaves plant^{-1} were observed.

These results are in agreement with those obtained by Tawaraya *et al.,* (2007) who reported that the number of leaves has also been increased by the application of nitrogen in Aloe Vera plant.

Table 2. Effect of nitrogen and planting time on number of leaves plant^{-1}.

	Nitrogen levels kg ha^{-1}				
Planting time	0	50	100	150	Mean
20th March	5	5	6	7	6a
04rth April	4	5	4	5	5b
20th April	4	4	4	6	4b
04rth May	3	4	5	4	4b
Mean	4b	4b	5b	6a	

LSD for Planting time = 0.8826
LSD for Nitrogen = 0.7015
LSD for Planting time x Nitrogen = 1.6752

Plant height (cm)

The data noted for plant height is presented in table 3. Analysis of variance revealed that nitrogen levels, planting time and their interaction significantly affected plant height. The data from mean table of planting time shows that the highest plant height (27.7 cm) was observed in the plants whose suckers were planted on 20th March followed by plants whose suckers were planted on 04rth April (24.2 cm) while the lowest plant height (23.8 cm) was observed in the plants whose suckers were planted on 04rth May. Similarly, mean table regarding nitrogen levels revealed that the highest plant height (26.3 cm) was noted in the plants treated with 150 kg nitrogen ha^{-1} followed by (24.5 cm) in the plants treated with 100 kg nitrogen ha^{-1} while the lowest plant heights (23.8 cm) was observed in plants applied with no nitrogen. Interaction showed the highest plant height (32 cm) was observed in the plants whose suckers were planted on 20th March with 150 kg nitrogen ha^{-1} while the lowest plant height (18.3 cm) was observed in the plants whose suckers were planted on 04rth May and applied with no nitrogen.

The increased number of leaves plant^{-1} was observed in suckers treated with 150 kg N ha^{-1}. That resulted in the production of high photosynthates. So cell division and cell elongation was enhanced due to the utilization of these more food contents. Hence highest plant height was observed in plants where maximum nitrogen application was applied. These results were similar to the findings of Suresh, (1980) who concluded that the application of nitrogen at 150 kg ha^{-1} was found to be optimum in developing plant height.

More nitrogen uptake from the soil by the root system of Aloe Vera plant could be the reason for the increase in plant height and gel content. The lowest plant height in control plot may be due to its poor nutritional status which resulted in retarded growth and reduced plant height.

The growth rate was boosted when the planted Suckers of March well established till April. Highest rate of metabolism occurred in April and thus the best results were obtained from plants planted in March. A similar observation has been reported by Soad *et al.,* (2001).

Table 3. Effect of nitrogen and planting time on plant height (cm).

	Nitrogen levels kg ha^{-1}				
Planting time	0	50	100	150	Mean
20th March	26.0	26.7	24.0	32.0	27.7a
04rth April	25.7	24.7	24.7	21.7	24.2b
20th April	23.3	23.3	23.3	26.0	24.0b
04rth May	18.3	21.0	26.0	25.7	23.8b
Mean	23.8b	23.9b	24.5b	26.3a	

LSD for Planting time = 2.6320
LSD for Nitrogen = 1.8105
LSD for Planting time x Nitrogen = 4.8126

Leaf breadth (cm)

The data recorded for leaf breadth is shown in table 4. Analysis of variance showed that there is a significant effect of nitrogen levels, planting time and their interaction on leaf breadth.

Means of planting time showed that the highest leaf breadth (2.98 cm) was observed in the plants whose suckers were planted on 20th March followed by plants whose suckers were planted on 04th April (2.63 cm) while the lowest leaf breadth (2.36 cm) was observed in the plants whose suckers were planted on 04th May.

Mean data concerning nitrogen levels revealed that the highest leaf breadth (2.92 cm) was noted in the plants received 150 kg nitrogen ha^{-1} followed by (2.68 cm) in the plants received nitrogen at 100 kg ha^{-1}, while the lowest leaf breadth (2.45 cm) was observed in plants applied with no nitrogen. In case of interaction the highest leaf breadth (3.83 cm) was observed in the plants whose suckers were planted on 20th March and treated with 150 kg nitrogen ha^{-1} while the lowest leaf breadth (2.45 cm) was observed in the plants whose suckers were planted on 04th May and applied with no nitrogen. More uptake of N from soil increase chlorophyll contents and indirectly enhances the photosynthates production. These photosynthates push the plants to produce more gel.

The highest leaf breadth may be due to the increase in the gel contents that caused the expansion of the leaves and in turn increased the leaf breadth. These findings are evident in the study of Saha *et al.,* (2005) who observed that the growth rate of leaf breadth in Aloe Vera was highest with the treatments where more percentage of nitrogen fertilizer was used. The plants planted in March established their roots from 15 to 20 days. A similar observation has been reported by Tawfik *et al.,* (2001).

Table 4. Effect of nitrogen and planting time on leaf breadth (cm).

	Nitrogen levels kg ha^{-1}				
Planting time	0	50	100	150	Mean
20th March	2.37	2.83	2.90	3.83	2.98a
04rth April	2.37	2.53	2.73	2.87	2.63b
20th April	2.77	2.57	2.67	2.53	2.63b
04rth May	2.30	2.27	2.43	2.43	2.36b
Mean	2.45b	2.55b	2.68ab	2.92a	

LSD for Planting time = 0.2921
LSD for Nitrogen = 0.3006
LSD for Planting time x Nitrogen = 0.5871

Leaf thickness (cm)

The data recorded for leaf thickness is given in table 5. Analysis of variance shows that nitrogen levels, planting time and their interaction significantly affected leaf thickness. Mean table of planting time showed that the highest leaf thickness (1.67 cm) was noted in the plants whose suckers were planted on 20th March followed by the plants whose suckers were planted on 04th April (1.47 cm) while the lowest leaf thickness (1.40 cm) was observed in the plants whose suckers were planted on 04th May. Similarly mean table regarding nitrogen levels revealed that the highest leaf thickness (1.67 cm) was noted in the plants treated with 150 kg nitrogen ha^{-1} followed by (1.54 cm) in the plants received nitrogen at 100 kg ha^{-1} while lowest leaf thickness (1.26 cm) was observed in plants applied with no nitrogen. Interaction between nitrogen and planting time showed that the highest leaf thickness (1.87 cm) was observed in the plants whose suckers were planted on 20th March and treated with 150 kg nitrogen ha^{-1} while the lowest leaf thickness (1.10 cm) was observed in the plants whose suckers were planted on 04th April and applied with no nitrogen.

Chloophyll contents effect the production of photosynthate. The higher the level of nitrogen the more will be the chlorophyll contents. As the photosynthates increase the growth parameters also shows best growing trend. These findings support the results of Hazrati *et al.,* (2012) who also observed that the highest values in leaf thickness are due to more dose of nitrogen to Aloe Vera plant. Tawfik *et al.,* (2001) reported that the offsets take a month to establish their roots. In spring metabolic activities are at peak that enhanced the growth components.

Table 5. Effect of nitrogen and planting time on leaf thickness (cm).

	Nitrogen levels kg ha^{-1}				
Planting time	0	50	100	150	Mean
20th March	1.57	1.63	1.60	1.87	1.67a
04rth April	1.10	1.37	1.60	1.80	1.47b
20th April	1.23	1.57	1.43	1.53	1.44b
04rth May	1.13	1.47	1.53	1.47	1.40b
Mean	1.26c	1.51b	1.54b	1.67a	

LSD for Planting time = 0.1051
LSD for Nitrogen = 0.1235
LSD for Planting time x Nitrogen = 0.2102

Leaf Volume (cm^3)

The data recorded for leaf volume is described in table 6. Data analysis showed that there is a significant effect of nitrogen levels, planting time and their interaction on leaf volume. Means of planting time revealed that the highest leaf volume (37.04cm^3) was observed in the plants whose suckers were planted on 20th March followed by the plants whose suckers were planted on 04th April (24.38cm^3) while the lowest leaf volume (21.11cm^3) was observed in the plants whose suckers were planted on 04th May.

The data from mean table of nitrogen levels shows that the highest leaf volume (34.77cm^3) was noted in the plants treated with 150 kg nitrogen ha^{-1} followed by (27.78cm^3) in the plants treated with 100 kg nitrogen ha^{-1} while the lowest leaf volume (19.47cm^3) was observed in the plants applied with no nitrogen.

In case of interaction the highest leaf volume (59.43cm^3) was observed in the plants whose suckers were planted on 20th March and dose of nitrogen with 150 kg ha^{-1}, while the lowest leaf volume (12.16 cm^3) was observed in the plants whose suckers were planted on 04th May and applied with no nitrogen.

Leaf volume is obtained through multiplication of the leaf breadth, length and thickness, an increase in these parameters was observed, as a result leaf volume also improved. Thus, leaf volume can be an important factor for the determination of leaf yield and leaf fresh weight Hernandez-Cruz *et al.,* (2002). The suckers take a month to establish their roots in soil. In spring the growth rate was observed relatively higher therefore leaf volume was enhanced due to formation of metabolic activities are at peak that enhanced the growth components.

Table 6. Effect of nitrogen and planting time on leaf volume (cm^3).

	Nitrogen levels kg ha^{-1}				
Planting time	0	50	100	150	Mean
20th March	27.09667	32.59	29.02333	38.42667	30.13a
04rth April	17.86333	22.22	28.28	29.15333	24.38a
20th April	20.74333	24.66	24.37	26.25333	24.01ab
04rth May	12.16	18.59333	29.43	24.23333	21.11b
Mean	19.47c	24.52bc	27.79ab	34.77a	

LSD for Planting time = 4.334
LSD for Nitrogen = 4.781
LSD for Planting time x Nitrogen = 8.875

Survival percentage

The data recorded for survival percentage is shown in table 7. Data analysis shows that the survival percentage was significantly affected by planting time while it was non- significantly affected by nitrogen levels and interaction of both planting time and nitrogen levels. Mean data concerning planting time revealed that the highest survival percentage (100%) was observed in the plants whose suckers were planted on 20th March followed by the plants whose suckers were planted on 04th April (90%) while the lowest survival percentage (88%) was observed in the plants whose suckers were planted on 04rth May. Mean table of nitrogen levels shows that the highest survival percentage (95%) was observed in the plants treated with 100 kg nitrogen ha^{-1} followed by (93%) in aloe plants treated with 150 kg nitrogen ha^{-1} while the lowest survival percentage (88%) was noted in control plants.

Interaction between planting time and nitrogen levels shows that the highest survival percentage (100%) was observed in the plants whose suckers were planted on 20th March and treated at of 100 kg nitrogen ha^{-1} while the lowest survival percentage (80%) was observed in 20th April and applied with no nitrogen.

This is the fact that Aloes are the only plants that remain green in very dry weather and are a future crop for global climatic change adaptation. These results are in accordance with those obtained by Wabuyele *et al.,* (2006) who stated that the survival ability of varieties of Aloe was not significantly influenced by fertilizer or manure application. Sacks *et al.,* (1995) stated that Aloe Vera is sensitive to cold and suffered winter injuries that caused the change in colour of epidermis, drying out of the upper parts of the leaves.

Table 7. Effect of nitrogen and planting time on survival percentage $plant^{-1}$.

	Nitrogen levels kg/ha^{-1}				
Planting time	0	50	100	150	Mean
20th March	100	100	100	100	100a
04rth April	87	93	87	93	90b
20th April	80	87	100	93	90b
04rth May	87	87	93	87	88b
Mean	88a	92a	95a	93a	

LSD for Planting time = 8.1884

Number of sucker's $plant^{-1}$

The data recorded for number of suckers $plant^{-1}$ is presented in table 8. Data analysis shows that the number of sucker's $plant^{-1}$ was significantly affected by Nitrogen levels and planting time while it was non-significantly affected by interaction of planting time and nitrogen levels. The mean table of planting time shows that the highest number of suckers $plant^{-1}$ (9.17) was observed in the plants whose suckers were planted on 20th March followed by the plants whose suckers were planted on 04th April (7.25) while the lowest number of suckers $plant^{-1}$ (5.42) was observed in the plants whose suckers were planted on 04th May. Similarly, mean table regarding nitrogen levels revealed that the highest number of suckers $plant^{-1}$ (9.83) was noted in the plants received nitrogen at

150 kg ha^{-1} followed by (7.58) in the plants treated with 100 kg nitrogen ha^{-1} while the lowest number of suckers plant^{-1} (3.75) was noted in plants applied without nitrogen.

Interaction shows the highest number of suckers plant^{-1} (10.67) was noted in the plants whose suckers were planted on 20th March and treated with 150 kg nitrogen ha^{-1} while the lowest number of suckers plant^{-1} (1.33) was observed in the plants whose suckers were planted on 04th May and applied with no nitrogen.

Aloe Vera plant is sensitive to cold winter injuries and severe frost negatively affects the no. of suckers. Aloe Vera plant hardly survives under such conditions the change in color of epidermis, drying out of the upper parts of the leaves prevents the plant to produce suckers Sacks *et al.,* (1995). These findings support the results of Hazrati *et al.,* (2012) who observed that the application of nitrogen had a significant effect on the number of offsets. The results of means comparison showed that an increase in nitrogen levels significantly increased the number of plant suckers. The highest number of suckers was observed in the plants treated with 1000 mg of nitrogen. The maximum number of offsets was observed due to the application of nitrogen in Aloe Vera plant Tawaraya *et al.,* (2007).

Table 8. Effect of nitrogen and planting time on number of sucker's plant^{-1}.

	Nitrogen levels kg/ha^{-1}				
Planting time	0	50	100	150	Mean
20th March	5.67	10.00	10.33	10.67	9.17a
04rth April	3.33	5.67	6.67	9.00	6.17b
20th April	4.67	7.00	7.00	10.33	7.25bc
04rth May	1.33	4.67	6.33	9.33	5.42c
Mean	3.75c	6.83b	7.58b	9.83a	

LSD for Planting time = 1.5190
LSD for Nitrogen = 1.4775

Leaf weight (gm)

The data recorded for leaf weight is presented in table 9. Analysis of variance shows that nitrogen levels, planting time and their interaction significantly affected leaf weight. Mean data concerning planting time revealed that the higher leaf weight (31.32gm) was observed in the plants whose suckers were planted on 20th March followed by the plants whose suckers were planted on 04th April (28.75gm) while the lowest leaf weight (24.92gm) was observed in the plants whose suckers were planted on 04th May. The data from the mean table of nitrogen levels revealed that the higher leaf weight (32.08gm) was noted in the plants treated with 150 kg nitrogen ha^{-1} followed by (27.41gm) in the plants treated with 100 kg nitrogen ha^{-1} while the lowest leaf weight (26.63gm) was observed in plants applied with no nitrogen. Interaction between nitrogen and planting time revealed that the higher leaf weight (34.55gm) was observed in the plants whose suckers were planted on 20th March and received at 150 kg ha^{-1} while the lowest leaf weight (20.33gm) was observed in the plants whose suckers were planted on 04th April and applied with no nitrogen.

Nitrogen is major component of chlorophyll. The more the nitrogen the higher will be the chlorophyll contents and hence more weight is achieved due to more vegetative growth. High rate of photosynthesis results in higher biomass production because of the higher level of nitrogen. Maiti and Chandra, (2002) reported that Aloe Vera could be transplanted throughout the year except from November to February under normal irrigated conditions. They further reported that Aloe Vera is xerophitic plant and thrives well in a bit higher temperature whereas the low temperature and elevated frost from November to February make the conditions unfavourable for the establishment of Aloe Vera plant. These findings are in agreement with Hazarati *et al.,* (2012) who reported that the nitrogen application increased leaf fresh weight and total biomass.

Table 9. Effect of nitrogen and planting time on leaf weight (gm).

	Nitrogen levels kg ha^{-1}				
Planting time	0	50	100	150	Mean
20th March	33.27	30.72	26.74	34.55	31.32a
04rth April	23.73	30.70	31.58	29.00	28.75a
20th April	26.25	25.59	28.66	31.33	27.96ab
04rth May	23.28	20.33	22.64	33.44	24.92b
Mean	26.63b	26.84b	27.41b	32.08a	

LSD for Planting time = 3.4506
LSD for Nitrogen = 3.6676
LSD for Planting time x Nitrogen = 6.993

Amount of Gel leaf^{-1} (gm)

The data recorded for amount of gel leaf^{-1} is presented in table 10. Analysis of variance describes that there is a significant effect of nitrogen levels, planting time and their interaction on amount of gel leaf^{-1}. Mean table of planting time shows that the highest amount of gel leaf^{-1} (13.8gm) was observed in the plants whose suckers were planted on 20th March followed by the plants whose suckers were planted on 04th April (12.65gm) while the lowest amount of gel plant^{-1} (9.45gm) was observed in the plants whose suckers were planted on 04th May. Mean table concerning nitrogen levels revealed that the highest amount of gel plant^{-1} (16.54gm) was noted in the plants treated with 150 kg nitrogen ha^{-1} followed by (13.07gm) in the plants treated with 100 kg nitrogen ha^{-1} while the lowest amount of gel leaf^{-1} (7.33gm) was noted in plants applied with no nitrogen. Interaction showed that the highest amount of gel plant^{-1} (21.75gm) was observed in the plants whose suckers were planted on 20th March and treated with 150 kg nitrogen ha^{-1} while the lowest amount of gel leaf^{-1} (3.96gm) was observed in the plants whose suckers were planted on 04th May and applied with no nitrogen.

Nitrogen is an essential nutrient and plays a vital role in production of chlorophyll. The more the chlorophyll content present in the leaf the highest will be the rate of photosynthesis and hence the best results in the amount of gel leaf^{-1} is obtained. The amount of gel was high because of the more liquid content inside the leaf of Aloe Vera plant. These results were in correspondence to Hernandez-Cruz *et al.,* (2002) who reported that the yield of Aloe Vera gel was increased with high amount of nitrogen fertilizer. Aloe Vera plant is sensitive to cold winter injuries and severe frost negatively affects the no. of suckers. Aloe Vera plant hardly survives under such conditions the change in color of epidermis, drying out of the upper parts of the leaves prevents the plant to produce suckers and loss of 5% gel production Sacks *et al.,* (1995).

Table 10. Effect of nitrogen and planting time on amount of gel plant^{-1} (gm).

	Nitrogen levels kg/ha^{-1}				
Planting time	0	50	100	150	Mean
20th March	5.95	11.65	16.02	21.75	13.84a
04rth April	11.67	14.53	9.79	14.59	12.65a
20th April	7.74	9.90	11.68	15.83	11.29ab
04rth May	3.96	5.05	14.80	13.98	9.45b
Mean	7.33c	10.28bc	13.07ab	16.54a	

LSD for Planting time = 2.9244
LSD for Nitrogen = 3.8775
LSD for Planting time x Nitrogen = 6.358

Conclusion

Since nitrogen level at 150 kg ha^{-1} has shown best results regarding growth and development of Aloe Vera plant, and therefore recommended for establishment and growth of *Aloe vera* plant. Sucker transplanted on 20th March has shown best results and therefore recommended for transplanting suckers of Aloe Vera in locality.

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