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Evaluation of the Performance of Aloe Vera under Different Locations of Ethiopia

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Abstract

The experiment was conducted during 2012- 2014 G.C. with the objectives of evaluating the adaptability of Aloe Vera under different locations of Ethiopia. The performance evaluation trials were conducted at three testing locations namely Hawassa, Koka and Wondo Genet; agronomic performance data was collected for two cycles. Testing location exerted significant ($P < 0.05$) influence on fresh weight of single leaf, fresh leaf weight/plant and fresh leaf yield/ha. Harvesting cycle exerted highly significant ($P < 0.0001$) influence on fresh weight of single leaf. Harvesting cycle had significant ($P<0.05$) influence on number of harvested leaves /plant, fresh leaf weight/plant and fresh leaf yield/hectare. Harvesting cycle two gave significantly higher fresh weight of single leaf, fresh leaf weight/plant and fresh leaf yield/hectare (tons). Even though it was not significant; higher plant height and percentage Jell continent was recorded during harvesting cycle two. Significantly higher number of suckers and number of harvested leaves per plant was recorded during harvesting cycle one. Interaction effect of harvesting cycle and location was significant ($P < 0.05$) on fresh weight of single leaf, fresh leaf weight/plant and fresh leaf yield/hectare. Number of suckers per plant was significantly ($P <0.01$) influenced by harvesting cycle and interaction effects of harvesting cycle with testing location. Plant height and percentage jell content of leaf were non-significantly influenced by harvesting cycle, testing location and their interaction effect.

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Combined mean performances results at the three testing locations over two harvesting cycles showed that the highest fresh leaf yield was recorded at Hawassa 45.5 tons/ha; whereas lowest leaf yield was recorded at Wondo genet 33.9 tons/ha. Fresh weight of single leaf ranged from 197.07g at Hawassa to 153.7g at Wondo genet. Number of suckers per plant ranged from 6 for Wondo genet to 4.2 for Hawassa.

Keywords: Aloe Vera; Aloe Jell; Adaptation; Ethiopia

1. Introduction

Aloe is a perennial drought resistant succulent plant belongs to Liliaceae family and it has African origin [3, 9]. The name Aloe is derived from the Arabic "alloeh" meaning bitter shiny substance [5]. Aloe Vera Linn or Aloe Barbadensis Miller is accepted unanimously as the correct botanical source of Aloe. In most reference books, *Aloe barbadensis Miller* is regarded as the correct name but as per the WHO monograph, *Aloe Vera Linn* is accepted as the legitimate name for this species [8].

The yellow sap from Aloe leaves named as aloin exudate has a bitter taste and used as a bettering agent in flavoring industries and it also has a laxative effects [4]. Whereas Aloe jell has long been in use for several diseases, particularly connected with the digestive system; it also been used for wounds, burns and skin problems. It contains at least three anti-inflammatory fatty acids, cholesterol, campesterol and β-sitosterol. These are highly effective in treatment of burns, cuts, scrapes, abrasions, allergic reactions, rheumatoid arthritis, rheumatic fever, acid indigestion, ulcers, plus many inflammatory conditions of the digestive system and other internal organs, including the stomach, small intestine, colon, liver, kidney and pancreas. β-sitosterol is also a powerful anti-cholesterol which helps to lower harmful cholesterol levels, explain its many benefits for heart patients, About 23 polypeptides are present in Aloe juice which helps to control a broad spectrum of immune system diseases and disorders [1, 2, 4, 8].

Aloe vera gel is useful for dry skin conditions, especially eczema around the eyes and sensitive facial skin. It is alleged that sap from Aloe vera eases pain and reduces inflammation. It has antiseptic and antibiotic properties which make it highly valuable in treating cuts and abrasions. It has also been commonly used to treat first and second degree burns and sunburns. It can also be used as a hair styling gel and works especially well for curly or fuzzy hair. It is also used for making moisturizers, soaps, sunscreens, shampoos and lotions [4]. The plant has got diverse potential uses and having an increasing demand and that in turn is increasing investors and entrepreneur's interest to cultivate the plant in large scale and using out growers scheme in Ethiopia. However, as the country has diverse agro-ecologies, the adaptability of the plant at different parts of the country is not known. Hence, this activity was designed with the objective of evaluating the adaptability of the Aloe Vera under different locations of Ethiopia.

2. Materials and Methods

The experiment was conducted during 2012- 2014 G.C. at three different locations namely Hawassa, Koka and Wondo Genet for two cycles. The ecological descriptions of the testing locations are summarized in table 1 below.

Table 1: Summarized description of the sites used for adaptation testing of *Aloe vera* for yield and yield components

Testing locations	Latitude	Longitude	Altitude (m.a.s.l)	Soil PH	Soil type	Rain fall (mm)	Annual Av. Temp. (^{o}c)	
							Mini.	Max.
Hawassa	7°05' N	39°29' E	1652	7.2	Sandy loam (Andosol)	964	12.94	27.34
koka	8^{o}45'N	38^{o}59'E	1891	6.9	Black Heavy clay (Vertisols)	851	11.42	26.31
Wondo Genet	7°19' N	38°38' E	1776	6.4	Sandy clay loam (Nitosol)	1000	12.02	26.72

Suckers were taken from a disease free mother plants maintained at Wondo Genet Agricultural Research Center botanical garden for seedling preparation. Seedlings were raised in the nursery for six months in polyethylene pots before being transplanted to the field experimental plots. During experimentation, all nursery and field horticultural practices were performed as required.

The adaptation testing trial was conducted using randomized complete block design with three replications. Each plot was having 2.8 m width and 2.8 m length. Spacing between replications, rows and plants was 1 m, 70 cm and 70 cm respectively.

Data collection was done twelve months after transplanting; subsequent harvesting was done twelve months after the first harvest. Data on plant height, number of suckers/plant, number of harvested leaves/plant, fresh weight of single leaf, fresh leaf weight/plant, fresh jel weight/plant, fresh leaf yield per hectare and percentage Jell content of leaf were recorded. Experimental data was subjected to analysis of variance (ANOVA) using SAS PROC GLM procedure at $P < 0.05$. Differences between means were assessed using the least significance difference (LSD) test at $P < 0.05$.

3. Results and Discussions

Mean squares from the combined analysis of variance for seven parameters are summarized on Table 2. Mean squares from the combined analysis of variance revealed number of suckers per plant was significantly (P <0.01) influenced by change in testing location. Testing location exerted significant ($P < 0.05$) influence on fresh weight of single leaf, fresh leaf weight/plant and fresh leaf yield/ha.

Table 2: Mean squares from combined analysis of variance for agronomic characters and yield of Aloe (*Aloe vera L.*) tested over three locations and two harvesting cycles.

Source of variation	Df	PH	NSPP	NHLPP	FWSL	FLWPP	PJC	FLYPH
Replication	2	1.44	0.23	0.67	251.59	0.065	0.003	26.4
Cycle	1	0.31 NS	8.13 **	19.63*	15747***	0.461*	0.0001NS	187.3*
Location	2	3.0 NS	5.37 **	0.75 NS	2861.76*	0.497*	0.003 NS	202.3*
Cycle.*Loc.	2	10.6 NS	4.87 **	1.07 NS	2287.86*	0.466*	0.72 NS	189.4*
Error	10	6.52	0.31	1.29	360.12	0.0706	0.005	28.67
CV (%)		5.66	10.66	9.99	10.72	13.38	12.67	13.38
LSD $_{0.05}$		3.28	0.72	1.46	24.4	0.34	0.09	6.89

*** = Significant at P< 0.001, ** = Significant at P< 0.01, * = Significant at P < 0.05, Df. = Degree of freedom, PH = Plant height (cm), NSPP = Number of Sucker /plant, NHLPP=Number of harvested leaves per plant, FWSL=Fresh weight of single leaf (g), FLWPP =Fresh leaf weight/plant (kg), PJC=Percentage Jell content (%) and FLYPH = Fresh leaf yield/hectare (tons).

As shown in Table 2, the independent variable harvesting cycle exerted highly significant (*P < 0.0001*) influence on fresh weight of single leaf. Harvesting cycle had significant (P<0.05) influence on number of harvested leaves /plant, fresh leaf weight/plant and fresh leaf yield/hectare. Interaction effect of harvesting cycle and location was significant (P < 0.05) on fresh weight of single leaf, fresh leaf weight/plant and fresh leaf yield/hectare. Number of suckers per plant was significantly (P <0.01) influenced by harvesting cycle and interaction effects of harvesting cycle with testing location. Plant height and percentage jell content of leaf were non-significantly influenced by harvesting cycle, testing location and their interaction effect.

Table 3: Mean agronomic and yield performance of Aloe (*Aloe vera L.*) on two harvesting cycles over all the three testing locations

Harvesting Cycles/years	PH(cm)	NSPP	NHLPP	FWSL (g)	FLWPP (kg)	PJC (%)	FLYPH (tons)
Cycle 01	44.98 ^{a}	5.9 ^{a}	12.4 ^{a}	147.4 ^{b}	1.82 ^{b}	0.55 ^{a}	36.81 ^{b}
Cycle 02	45.24 ^{a}	4.59 ^{b}	10.3 ^{b}	206.5 ^{a}	2.15 ^{a}	0.56 ^{a}	43.26 ^{a}
CV (%)	5.66	10.66	9.99	10.72	13.38	12.67	13.38
LSD $_{0.05}$	2.68	0.59	1.19	19.93	0.28	0.074	5.63

Means followed by the same letter with in the same column are statistically non significant at P < 0.05 according to least significant difference (LSD) test; PH = Plant height (cm), NSPP = Number of Sucker /plant, NHLPP=Number of harvested leaves per plant, FWSL=Fresh weight of single leaf (g), FLWPP =Fresh leaf weight/plant (kg), PJC=Percentage Jell content (%) and FLYPH = Fresh leaf yield/hectare (tons)

As shown on Table 3, harvesting cycle two gave significantly higher fresh weight of single leaf, fresh leaf weight/plant and fresh leaf yield/hectare (tons). Even though it was not significant; higher plant height and percentage Jell continent was recorded on harvesting cycle two. Higher number of suckers and number of harvested leaves per plant was recorded on harvesting cycle one.

Table 4: Mean performance of Aloe (*Aloe vera L.*) for agronomic traits and yield at the three testing locations during the two harvesting cycles.

Location	PH (cm)	NSPP	NHLPP	FWSL (g)	FLWPP (kg)	PJC (%)	FLYPH (tons)
Hawassa	45.9 [a]	4.2 [b]	11.73 [a]	197.07 [a]	2.26 [a]	0.55 [a]	45.50 [a]
Koka	44.7 [a]	5.6 [a]	11.30 [a]	180.12 [a]	2.02 [ab]	0.58 [a]	40.66 [ab]
Wondo Genet	44.7 [a]	6.0 [a]	11.03 [a]	153.73 [b]	1.68 [b]	0.53 [a]	33.94 [b]
CV (%)	5.66	10.66	9.99	10.72	13.38	12.67	13.38
$LSD_{0.05}$	3.28	0.72	1.46	24.41	0.34	0.09	6.89

Means followed by the same letter with in the same column are statistically non-significant at P < 0.05 according to least significant difference (LSD) test; PH = Plant height (cm), NSPP = Number of Sucker /plant, NHLPP=Number of harvested leaves per plant, FWSL=Fresh weight of single leaf (g), FLWPP =Fresh leaf weight/plant (kg), PJC=Percentage Jell content (%) and FLYPH = Fresh leaf yield/hectare (tons)

Mean performances results at the three testing locations (Table 4) shows that the highest fresh leaf yield was recorded at Hawassa 45.5 (tons/ha); whereas lowest leaf yield was recorded at Wondo genet (33.9 tons/ha). Fresh weight of single leaf ranged from 197.07g (Hawassa) to 153.7g (Wondo genet). Number of suckers per plant ranged from 6 for Wondo genet to 4.2 for Hawassa. Non-significant difference was recorded among testing locations on plant height, number of harvested leaves per plant and percentage jell content.

Many research activities on Aloe Vera focus on chemical composition and chemical properties of Aloe Vera. Few research activities on yield and agronomic traits of Aloe vera suggest that the yield and agronomic performance of Aloe Vera is largely influence by agro-ecological conditions of the growing areas, harvesting age and crop management. For instance, on a study of the performance of Aloe Vera at different levels of nitrogen application; 262.36 g fresh leaf weight and 171.6 g gel weight/leaf was found without nitrogen application [9]. An average fresh Aloe vera leaf yield of 12 tons per hectare was reported in India under organic cultivation [8]. Fresh leaf yield ranging from 18 to 20.6 tons per hectare was found in comparison study of the

effect of bare soil as compared to mulching on Aloe Vera performance [7]. Fresh leaf weight of Aloe vera was increased by 175 % when it was harvested four years after planting as compared to a harvest made one year after planting [6].The yield and agronomic performance Aloe Vera on the current experiment is higher and comparable to results obtained elsewhere, indicating that Aloe Vera is well adapted to the growing conditions of the testing locations.

4. Conclusion

Yield and agronomic performance of Aloe Vera in the current trial is comparable with the results of similar studies elsewhere, indicating that Aloe Vera can be produced on the tested locations and similar agro-ecologies of the country for various purpose of utilization and gaining the economic benefit of the plant

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References

[1] Alessandro B. and Stefano S. (2005). The Great Aloe Book: History, botany, composition, and pharmacological aspects of this legendary plant. Trento: Zuccari PLC

[2] Beatriz V., Avila, G., Segura, D., Escalante, B. (1996). “Anti- inflammatory activity of extracts from Aloe Vera gel” Journal of Ethno-Pharmacology vol. 55, pp. 69-75

[3] Biswas B.C., (2010) “Cultivation of Medicinal Plant, success stories of two farmers”, Indian Fertilizer Marketing News (March,2010).vol. 41 no.3, pp. 1-4 &20

[4] Josias H. Hamman (2008). “Composition and Applications of Aloe vera Leaf Gel”, Molecules vol. 13, pp 1599-1616

[5] Karkala M. and Bhushan B. (2014).” Aloe vera: a wonder plant its history, cultivation and medicinal uses” Journal of Pharmacognosy and Phytochemistry, vol. 2 no.5 pp. 85-88

[6] Kulveer S., Neelam G., Bhupendar S.(2013). “Effect of plant maturity on leaf growth, yield and physicochemical properties of Aloe Vera Gel” Food Analysis, Agro Food Industry Hi Tech. vol. 24 no.1, pp.35-37.

[7]. Luis R., Hernández C.,Raúl R.,Diana J., and José L. (2002). ‘’*Aloe vera* response to plastic mulch and nitrogen’’ in Trends in new crops and new uses 1st ed. J. Janick and A. Whipkey, Ed. Alexandria: ASHS Press, pp. 570-574

[8]. Rajeswari R, Umadevi M., Sharmila R., R.Pushpa, S. Selvavenkadesh, K, Sampath P and Debjit B. (2012). “Aloe vera: The Miracle Plant its Medicinal and Traditional Uses in India.” Journal of Pharmacognosy and Phytochemistry, vol. 1 no 4, pp. 118-124

[9]. Saeid H., Zeinolabedin T. and Amin S. (2012).” The effect of differential nitrogen fertilization on morphological and physiological traits of Aloe vera plants” International Research Journal of Applied and Basic sciences vol. 3 no.4, pp. 682-687