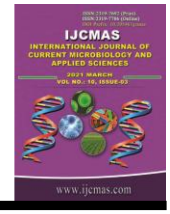
Int.J.Curr.Microbiol.App.Sci (2021) *10*(03): 875-884

EXCELLENT PUBLISHERS

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 10 Number 03 (2021)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2021.1003.110

Performance of Plant Growth Hormones on Yield Characteristics of Alfalfa (*Medicago sativa* L.) under Northern Dry Zone of Karnataka

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ABSTRACT

Keywords

Alfalfa, Plant growth hormones, GA_3, Yield attributes

Article Info

Accepted:
10 February 2021
Available Online:
10 March 2021

Alfalfa is an important medicinal plant having stachydrine as alkaloid and used as laxative, digestive, diuretic and treating for dropsy, blood pressure, hair loss, acidity and arthritis. Present investigation was carried out during *rabi* season 2019-20, Dept. of PMA, College of Horticulture, Bagalkote with the objective to study the effect of plant growth hormones on yield characteristics of Alfalfa (*Medicago sativa* L.) under Northern dry Zone of Karnataka. In this experiment, the growth hormones *viz*., GA_3 (50 ppm and 100 ppm), IAA (50 ppm and 100 ppm), NAA (50 ppm and100 ppm), Kinetin (50 ppm and 100 ppm), Humic acid (4.0ml/l and 6.0ml/l), Salicylic acid (1.5 g/l and 3 g/l) and water as control were sprayed at 30, 60, 90 and 120 days after sowing and analysed for yield parameters. Among different growth hormones, the plants sprayed with GA_3 at 100 ppm showed significantly highest fresh leaves weight (41.17, 46.77, 36.20 and 27.67 g/plant), fresh stem weight (33.03, 33.51, 24.27 and 22.40 g/plant), fresh herbage yield per hectare (16.59, 17.73, 13.43 and 11.12t/ha), highest dry leaves weight (8.52, 9.71, 7.97 and 7.32 g/plant), stem dry weight (8.98, 9.57, 8.71, 8.09 g/plant) and dry herbage yield (4.01, 4.15, 3.70 and 3.42t/ha) at I, II, III and IV harvest i.e. on 50, 80, 110 and 140 DAS, respectively. It is concluded that foliar application of plant growth regulators at different intervals significantly increased the alfalfa yield as compared to control. This study specified that, among different growth regulators, the plants sprayed withGA_3 at 100 ppm showed better results for yield attributes of alfalfa.

Introduction

Alfalfa is a perennial herb plant that belongs to the family Fabaceae, scientifically known as *Medicago sativa* L. In India, commonly it is called Lucerne, in Hindi called as 'Rijika' and in Kannada, it is known as Kudure menthe'. It is popularly considered as 'Queen of the fodder crops'. The native of alfalfa goes to Southwest Asia. Alfalfa is widely grown as a source of high-quality fodder for livestock and it is also a good source of phytochemicals, so it is used as a human food ingredient, like sprouts in saladsor soups, as leaf protein, or as food supplements (Barreira *et al.,* 2015).

Alfalfa is a perennial legume herb that can be grow for 4-8 years but can live more than 20years, depending on climate and variety. It is usually having a height of 100-130 cm with a deep root system. Leaves are vibrant green in colour with oblong or ovate and leaves are alternately arranged on the stem and are generally trifoliate (Bagavathiannan and Van-Acker, 2009). Flowers which are bluish-violet borne in loose clusters. Pods are the sickle type to those that are twisted into spirals. Each pod contains small kidney-shaped seeds. Stems are erect and new growth occurs from buds in the crown (Aganga and Tshwenyane, 2003).

Globally, lucerne is cultivated over an area of 35 million hectares with forage yield of 5-7.5 MT per hectare per year involving 8-12 cuttings. Annual seed yield is 186-280 kg ha^{-1}. In India, alfalfa is grown in about one million hectares area and provides 60 to 130 tons of green forage per hectare. Alfalfa is mainly grown in Punjab, Western Uttar Pradesh, Maharashtra, Gujarat, West Bengal and Tamil Nadu (Iqbal *et al.,* 2018).

The Lucerne is beneficial to both humans and animals health. Alfalfa sprouts, tender stems, dehydrated alfalfa leaf used as a dietary supplement in forms such as tablets, powders and tea, whereas its forage, harvested hay and as fodder form used for the animal consumption. Alfalfa has a long traditional use ashomeopathic and ayurvedic medicine for central nervous system disorders. All kinds of livestock relish alfalfa as it yields nutritious and palatable green fodder, which contains protein (13.3-26.6 %), phosphorus (0.14–0.66 %), calcium (0.92–2.9 %), carotene (9.27 mg/100 g), fiber (20-30 %) and vitamin A and C (Khalak, 1989; Charkey *et al.,* 1961; Colodny *et al.,* 2001).

People consume lucerne as a green leafy vegetable, a rich source of vitamins A, C, E, K, niacin, thiamin, riboflavin and minerals like calcium, potassium, phosphorous, magnesium and iron. Alfalfa has a unique feature that it contains vitamin B_{12}, since vitamin B_{12} are only found in meat sources. So, for vegetarian this vitamin can be provided by alfalfa. Alfalfa is an important medicinal plant with stachydrine as alkaloid, used as laxative and digestive(Francis *et al.,* 2002). It is also used asdiuretic and treating for dropsy, blood pressure, hair loss, acidity and arthritis. The plant has been described to have an antioxidant, anti-inflammatory and antidiabetic effects (Bora and Sharma, 2011). Besides several other pharmacological activities have been reported for alfalfa, leading to their use in health dysfunctions, such as anemia (Barnes *et al.,* 2002), endometriosis, stomach ulcers, osteoporosis, menopausal symptoms, prostate and breast cancers and low bone density (Mortensen *et al.,* 2009).

To meet the over generating demand of alfalfa as a food supplements for rapidly growing population, there are many yield boosting agronomical techniques applied and one among them is plant growth regulators.Plant growth regulators refer to natural or synthetic substances which influence the growth and development of the plant. It plays a vital role in producing high-value horticultural crops and increases the produce quality and yield (Emongor, 2007).

The exploitation of the efficacy of growth regulators for enhancing growth, yield and quality has been proven scientifically in many crops for crop production and output.Keeping this view, an investigation entitled "Role of growth regulators on yield of Alfalfa (*Medicago sativa* L.) under Northern dry Zone of Karnataka" was carried out at the College of Horticulture, Bagalkote.

Materials and Methods

The field experiment was carried out at Department of PMA, College of Horticulture, University of Horticultural Sciences, Bagalkote, at an altitude of 533 meters above mean sea level (MSL) at 16^0 16' 37" N latitude and 74^0 61' 24" E longitude in the northern dry zone of Karnataka (zone-III) which receives annual rainfall of 682 mm. The soil of the experimental site was clay loamy with the pH of 8.62, EC (0.35 dS/m) and organic carbon content (0.36%). The field experiment was laid out in to Randomized Complete Block Design (RCBD) with thirteen treatments and three replications. Land was ploughed two times, harrowed once and levelled, then plots were made. After land preparation well decayed farmyard manure applied at the rate of 20 tons per hectare. The field was divided into plot of 1.8 x 1.8 m size. Recommended dose of fertilizer (20: 100: 40 NPK kg/ha) was applied in the form of Urea, Single Super Phosphate and Muriate of Potash. Half dose of nitrogen, full dose of potash and phosphorous were applied as basal dose and remaining nitrogen was given after 30 days after sowing (DAS). The variety of lucerne used for sowing was RL – 88. The seeds were sown in line as per the recommended seed rate (15 kg/ha), with proper spacing (30 x 15 cm).A light irrigation was given after sowing of seeds and frequent irrigations during early growth period at an interval of 7 days. Later subsequent irrigations were given to the crop at different intervals according to the need of crop.

The experiment was consisted of 13 treatments *viz.*, Control (water) (T_1), GA_3@ 50 ppm (T_2),GA_3@ 100 ppm (T_3), IAA @ 50 ppm (T_4),IAA @ 100 ppm (T_5),NAA @ 50 ppm (T_6),NAA @ 100 ppm (T_7),Kinetin @ 50 ppm (T_8),Kinetin @ 100 ppm (T_9),Humic acid (15%) @ 4.0ml/l (T_{10}), Humic acid (15%) @ 6.0ml/l (T_{11}), Salicylic acid @ 1.5 g/l (T_{12}) and Salicylic acid @ 3.0 g/l (T_{13}).Growth regulators are sprayed on 30, 60, 90 and 120 days after sowing. 3000 ml of solution was used for foliar spraying under each treatment in all the three replications later five plants from each plot were randomly chosen and then labelled for recording the observations. The plants present at border row were avoided. Yield parameters are recorded on 50, 80, 110 and 140 days after sowing (DAS). Observation from the same five plants are taken which are regrown from the ratoon after every harvest. The first harvest of the crop was done at 50 DAS and further ratoon crops were harvested on 80, 110 and 140 DAS. The crops are cut at a height of 5 cm from ground level. The observations were recorded on yield parameters viz., fresh leaves weight (g/plant), fresh stem weight (g/plant), fresh herbage yield per hectare (t/ha), highest dry leaves weight (g/plant), stem dry weight (g/plant) and dry herbage yield (t/ha). The experimental data were subjected to statistical analysis of variance according to Panse and Sukhatme (1967).

Results and Discussion

Fresh leaves weight (g/ plant)

The data pertaining to fresh yield of leaves of alfalfa as influenced by plant growth regulators at I, II, III and IV harvest was shown in Table 1. There was statistical difference in fresh weight of leaves among different treatments with GA_3 at 100 ppm registered maximum fresh weight of leaves (41.17, 46.77, 36.20 and 27.67 g/plant) and least fresh weight of leaves (20.13, 21.40, 17.06 and 15.31 g/plant) was observed in control at I, II, III and IV harvest respectively. By GA_3 application, increases the leaf related traits especially leaf area which correlate with increase in fresh weight of leaves. Our findings were in accordance with the outcomes of Hassanpouraghdam *et al.,* (2011) in lavender, Akter *et al.,* (2007) in mustard and EL-Naggar *et al.,* (2009).

Fresh stem weight (g/ plant)

There was a considerable difference of fresh stem weight when plants were sprayed with various growth regulators are recorded at I, II, III and IV harvest has been presented in Table 2. GA_3 at 100 ppm noticed for its highest fresh stem weight of 33.03, 33.51, 24.27 and 22.40 g/plant at I, II, III and IV harvest respectively. While, control noted less for its fresh stem weight of a single plant (13.97, 17.27, 14.85 and 11.26 g/ plant) at I, II, III and IV harvest respectively. Stem fresh weight increment may be due to higher shoot length and accumulation of some biomolecules mainly responsible for cell division and subsequent enlargement and this leads to higher accumulation of dry matter. These finding are in accordance with the results of Akter *et al.,* (2007) in mustard and EL-Naggar *et al.,* (2009).

Table.1 Fresh leaves weight (g/plant) in alfalfa (*Medicago sativa* L.) at different harvest as influenced by growth regulators

Treatments	I Harvest (50DAS)	II Harvest (80DAS)	III Harvest (110DAS)	IV Harvest (140DAS)
T_1 – Control	20.13	21.40	17.06	15.31
T_2 – GA_3 at 50 ppm	34.33	40.83	29.77	24.43
T_3 – GA_3 at 100 ppm	41.17	46.77	36.20	27.67
T_4 – IAA at 50 ppm	27.90	31.57	23.20	19.65
T_5 –IAA at 100 ppm	23.75	27.40	20.00	17.85
T_6 – NAA at 50 ppm	30.93	36.70	26.60	22.53
T_7 – NAA at 100 ppm	25.72	28.02	21.50	18.04
T_8 – Kinetin at 50 ppm	37.20	42.03	31.97	26.25
T_9 –Kinetin at 100 ppm	28.53	33.10	24.50	20.11
T_{10} – Humic acid (15%) at 4.0 ml/l	26.20	28.13	22.90	18.33
T_{11} – Humic acid (15%) at 6.0 ml/l	33.50	39.33	27.50	22.54
T_{12} – Salicylic acid at 1.5 g/l	21.23	26.50	19.93	17.80
T_{13} –Salicylic acid at 3.0 g/l	29.83	32.70	25.51	20.94
S.Em±	**1.20**	**1.60**	**1.34**	**1.02**
CD at 5%	**3.50**	**4.67**	**3.91**	**2.98**

DAS- Days after sowing

Table.2 Fresh stem weight (g/plant) in alfalfa (*Medicago sativa* L.) at different harvest as influenced by growth regulators

Treatments	I Harvest (50DAS)	II Harvest (80DAS)	III Harvest (110DAS)	IV Harvest (140DAS)
T_1 – Control	13.97	17.27	14.85	11.26
T_2 – GA_3 at 50 ppm	27.67	27.70	20.77	18.95
T_3 – GA_3 at 100 ppm	33.03	33.51	24.27	22.40
T_4 – IAA at 50 ppm	22.67	22.63	18.50	16.07
T_5 –IAA at 100 ppm	17.77	21.45	17.51	14.59
T_6 – NAA at 50 ppm	26.40	24.70	19.93	17.47
T_7 – NAA at 100 ppm	17.90	22.33	17.67	14.81
T_8 – Kinetin at 50 ppm	28.90	29.17	21.33	19.41
T_9 –Kinetin at 100 ppm	25.13	22.77	18.70	16.11
T_{10} – Humic acid (15%) at 4.0 ml/l	19.55	22.53	18.02	15.47
T_{11} – Humic acid (15%) at 6.0 ml/l	25.80	26.43	20.30	18.29
T_{12} – Salicylic acid at 1.5 g/l	16.18	18.80	15.47	13.47
T_{13} –Salicylic acid at 3.0 g/l	23.23	25.17	19.32	16.89
S.Em±	**1.08**	**1.36**	**0.95**	**0.93**
CD at 5%	**3.14**	**3.98**	**2.78**	**2.70**

DAS- Days after sowing

Table.3 Dry leaves weight (g/plant) in alfalfa (*Medicago sativa* L.) at different harvest as influenced by growth regulators

Treatments	I Harvest (50DAS)	II Harvest (80DAS)	III Harvest (110DAS)	IV Harvest (140DAS)
T_1 – Control	3.03	3.49	2.75	2.17
T_2 – GA_3 at 50 ppm	7.20	7.44	7.06	6.08
T_3 – GA_3 at 100 ppm	8.52	9.71	7.97	7.32
T_4 – IAA at 50 ppm	5.40	5.08	5.46	4.52
T_5 –IAA at 100 ppm	4.47	4.42	4.02	3.38
T_6 – NAA at 50 ppm	6.74	7.02	6.81	5.98
T_7 – NAA at 100 ppm	5.35	4.87	5.22	4.27
T_8 – Kinetin at 50 ppm	7.49	7.87	7.45	6.38
T_9 –Kinetin at 100 ppm	6.30	6.23	5.81	5.06
T_{10} – Humic acid (15%) at 4.0 ml/l	4.61	4.78	4.84	4.04
T_{11} – Humic acid (15%) at 6.0 ml/l	6.44	6.54	6.08	5.72
T_{12} – Salicylic acid at 1.5 g/l	4.35	4.28	3.27	2.75
T_{13} –Salicylic acid at 3.0 g/l	5.68	5.57	5.75	4.79
S.Em±	**0.31**	**0.44**	**0.37**	**0.29**
CD at 5%	**0.92**	**1.27**	**1.09**	**0.85**

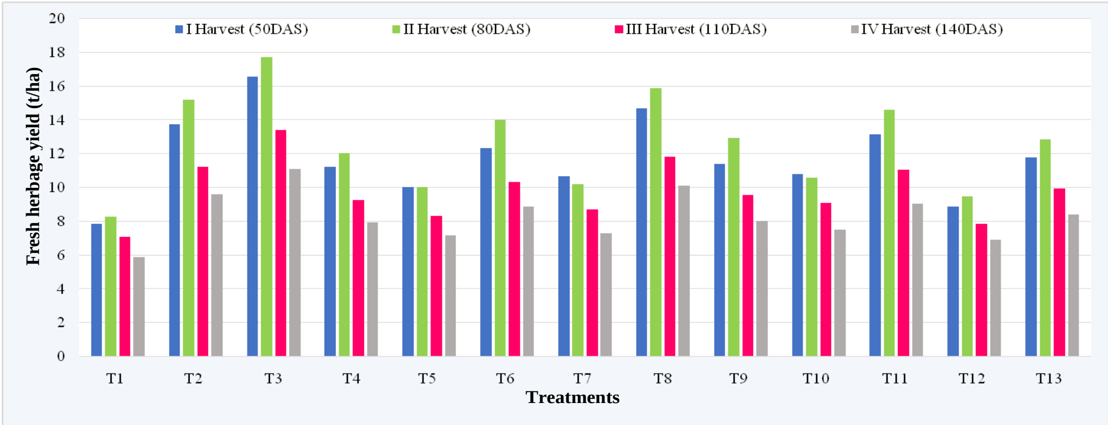
DAS- Days after sowing

Table.4 Dry stem weight (g/plant) in alfalfa (*Medicago sativa* L.) at different harvest as influenced by growth regulators

Treatments	I Harvest (50DAS)	II Harvest (80DAS)	III Harvest (110DAS)	IV Harvest (140DAS)
T_1 – Control	2.27	3.17	2.32	1.82
T_2 – GA_3 at 50 ppm	7.76	8.08	7.35	6.98
T_3 – GA_3 at 100 ppm	8.98	9.57	8.71	8.09
T_4 – IAA at 50 ppm	5.87	6.31	5.01	5.14
T_5 –IAA at 100 ppm	4.97	4.80	3.81	3.91
T_6 – NAA at 50 ppm	7.52	7.59	7.16	6.90
T_7 – NAA at 100 ppm	5.50	6.00	4.99	4.56
T_8 – Kinetin at 50 ppm	7.94	9.03	7.78	7.13
T_9 –Kinetin at 100 ppm	6.61	6.77	6.04	6.03
T_{10} – Humic acid (15%) at 4.0 ml/l	5.32	5.78	4.71	4.14
T_{11} – Humic acid (15%) at 6.0 ml/l	7.35	7.16	6.15	6.56
T_{12} – Salicylic acid at 1.5 g/l	3.96	3.91	3.50	3.63
T_{13} –Salicylic acid at 3.0 g/l	6.47	6.58	5.75	5.75
S.Em±	**0.33**	**0.43**	**0.32**	**0.32**
CD at 5%	**0.97**	**1.27**	**0.93**	**0.94**

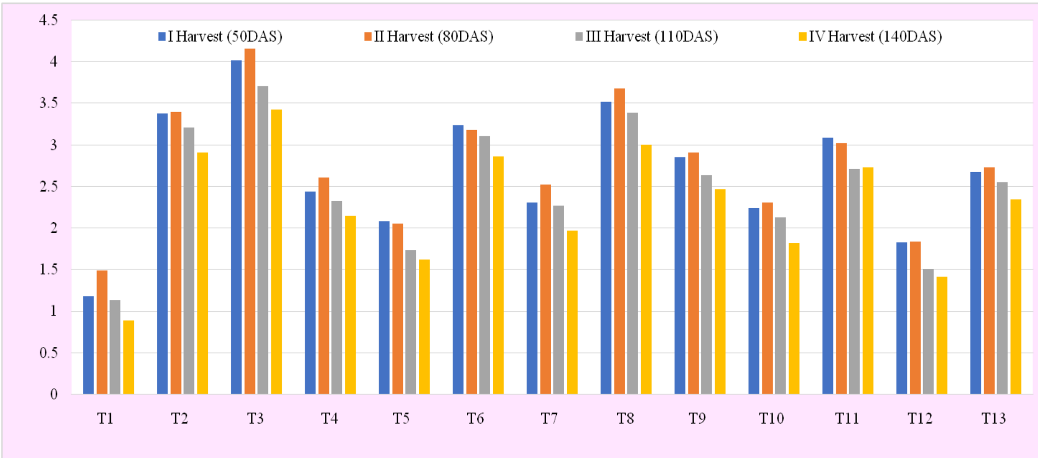
DAS- Days after sowing

Fig.1 Fresh herbage yield (t/ha) in alfalfa (*Medicago sativa* L.) at different harvest as influenced by growth regulators



T_1 – Control
T_2 – GA_3 at 50 ppm
T_3 – GA_3 at 100 ppm
T_4 – IAA at 50 ppm
T_5 – IAA at 100 ppm
T_6 – NAA at 50 ppm
T_7 – NAA at 100 ppm
T_8 – Kinetin at 50 ppm
T_9 – Kinetin at 100 ppm
T_{10} – Humic acid (15%) at 4.0ml/l
T_{11} – Humic acid (15%) at 6.0ml/l
T_{12} – Salicylic acid at 1.5 g/l
T_{13} – Salicylic acid at 3.0 g/l
DAS- Days after sowing

Fig.2 Dry herbage yield (t/ha) in alfalfa (*Medicago sativa* L.) at different harvest as influenced by growth regulators



T_1 – Control
T_2 – GA_3 at 50 ppm
T_3 – GA_3 at 100 ppm
T_4 – IAA at 50 ppm
T_5 – IAA at 100 ppm

T_6 – NAA at 50 ppm
T_7 – NAA at 100 ppm
T_8 – Kinetin at 50 ppm
T_9 – Kinetin at 100 ppm
T_{10} – Humic acid (15%) at 4.0ml/l

T_{11} – Humic acid (15%) at 6.0ml/l
T_{12} – Salicylic acid at 1.5 g/l
T_{13} – Salicylic acid at 3.0 g/l
DAS- Days after sowing

Fresh herbage yield (t/ha)

The data related to fresh herbage yield as influenced by plant growth regulators at I, II, III and IV harvest was disclosed in Fig. 1. The fresh herbage yield was significantly affected by different plant growth regulators, GA_3 at 100 ppm reported the significantly higher fresh herbage yield per hectare (16.59, 17.73, 13.43 and 11.12 t/ ha at I, II, III and IV harvest respectively). While, the least fresh herbage yield per hectare was recorded in control (7.85, 8.31, 7.09 and 5.90 t/ ha) at I, II, III and IV harvest respectively. The increase in the herbage yield mainly due to the fact that the growth regulators increase the number of leaves production which results in the production and accumulation of more photosynthates. Similar results have been recorded by Kumari and Umesha (2018) in *Andrographis paniculata* Nees. Mishriky (1990) celery (*Apium graveolens*) and Hassanpouraghdam *et al.,* (2011) in lavender.

Dry weight of leaves (g/plant)

The data pertaining to the influence of plant growth hormones on dry weight of leaves in alfalfa at I, II, III and IV harvest was presented in Table 3. The perusal of the data shows that, the dry weight of alfalfa leaves per plant provided with GA_3 at 100 ppm recorded maximum dry weight of leaves (8.52, 9.71, 7.97 and 7.32 g/plant at I, II, III and IV harvest respectively). However, the minimum dry weight of leaves was noticed in control (3.03, 3.49, 2.75 and 2.17 g/plant at I, II, III and IV harvest respectively). GA_3 as growth regulator has documented promoting effects on cell division and enlargement and consequently on some growth parameters such as number of leaves and leaf area. Such an increase in leaf related traits especially leaf area correlates with agglomerated dry weight and biomass. Our findings were in accordance with the results of Ali *et al.*, (2012) for *Hibiscus sabdariffa* L and EL-Naggar *et al.*, (2009).

Dry stem weight (g/plant)

There was a considerable difference of fresh stem weight when plants were sprayed with different plant growth hormones at I, II, III and IV harvest has been presented in Table 4. Growth hormones influenced the stem dry weight and highest value (8.98, 9.57, 8.71, 8.09 g/plant at I, II, III and IV harvest respectively) obtained from plants given with GA_3 at 100 ppm. The least stem dry weight was recorded in control (2.27, 3.17, 2.32 and 1.82 g/plant at I, II, III and IV harvest respectively). Stem dry weight increment may be due to the accumulation of some biomolecules mainly responsible for cell division and subsequent enlargement and this results in higher accumulation of dry matter. The present outcomes were more or less similar to the findings of Akter *et al.*, (2007) in mustard, Bishoi and Krishnamoorthy (1992), Fatima *et al.*, (2008), Chovatia *et al.*, (2010) and Sharma and Jain (2016).

Dry herbage yield (t/ha)

The data relating to dry herbage yield of alfalfa as influenced by plant growth regulators at I, II, III and IV harvest is shown in Fig. 2. GA_3 at 100 ppm showed the maximum dry herbage yield per hectare (4.01, 4.15, 3.70 and 3.42 t/ha at I, II, III and IV harvest respectively), while the least dry herb yield per plot was noticed in control (1.17, 1.48, 1.12 and 0.88 t/ha at I, II, III and IV harvest respectively). It might be due to the fact that, plants treated with GA_3 had increased plant height, branches and leaf area which might have facilitated the accumulation of more carbohydrates in terms of increased dry matter production. The present findings were in agreement with those reported by Binisundar *et al.*, (2008), Nandre *et al.*, (2009) and Doijode (1975) in garden pea.

In conclusion the application of plant growth regulators at different concentration plays an important role in alfalfa yield. All the applied growth regulators increase yield parameter as compared to control. Among different growth regulator and its concentrations, the plants sprayed with GA_3at 100 ppm showed better result for yield parameter with the increase in 228 per cent of yield which was followed by kinetin at 50 ppm with the increase in 191 per cent of yield over control.

References

Aganga, A. A. and Tshwenyane, S. O., 2003, Lucerne, lablab *and Leucaena leucocephala* forages: production and utilization for livestock production. *Pakistan J. Nutr.*, 2(2): 6-53.

Akter, E., Ali, M. M. Z., Islam, R., Karim, A. H. M. and Razzaque, 2007, Effect of GA_3 on growth and yield of mustard. *Int. J. Sustain. Crop Prod*., 2: 16-20.

Ali, H. M., Siddiqui, M. H., Basalah, M. O., Al-Whaibi, M. H., Sakran, A. M. and Al-Amri, A., 2012, Effects of gibberellic acid on growth and photosynthetic pigments of *Hibiscus sabdariffa* L. under salt stress. *African J. Biotech.*, 11(4): 800-804.

Bagavathiannan, M. V. and Van Acker, R. C., 2009, The biology and ecology of feral alfalfa (*Medicago sativa* L.) and its implications for novel trait confinement in North America. *Crit. Rev. Plant Sci.*, 28(1-2):69-87.

Barnes, J., Anderson, L. A. and Phillipson, J. D., 2002, Medicines, 2nd edition. -Pharmaceutical Press, London, pp. 38.

Barreira, J. C., Visnevschi-Necrasov, T., Nunes, E., Cunha, S.C., Pereira, G. and Oliveira, M. B. P., 2015, *Medicago* spp. as potential sources of bioactive isoflavones: characterization according to phylogenetic and phenologic factors. *Phytochemistry*, 116: 230-238.

Binisundar, S. T., Sadasakthi, A., Kumar, A. G. and Visnupriya M., 2008, Effect of growth regulators on growth and flowering in triploid crossandra (*Crossandra infundibuliformis*) Cv. Delhi. *Res. Crops*. 9(2): 335-337.

Bishoi, N. R. and Krishnamoorthy, H. N., 1992, Effect of gibberellic acid on chlorophyll content and photosynthesis in waterlogged Chickpea (*Cicer arietinum* L.).*Indian J. Exp. Bot.*, 30(9): 856-857.

Bora, K. S. and Sharma, A., 2011, Evaluation of antioxidant and cerebroprotective effect of *Medicago sativa* L. against ischemia and reperfusion insult. *Evid. Based Complement. Alternat. Med*., 1-9.

Charkey, L., Pyke, W. E., Kano, A. and Carlson, R. E., 1961, Alfalfa meal nutrients, the carotene and tocopherol content of dehydrated and sun-cured alfalfa meals. *J. Agric. Food Chem.*,9: 70-77.

Chovatia, R. S., Ahlawat, T. R., Mepa, S. V. and Jat. G., 2010, Response of cowpea (*Vigna unguiculata* L.) Cv. Guj-4 to the foliar application of plant growth regulating chemicals. *Vegetable Science*.37(2):196-197.

Colodny, L. R., Montgomery, A. and Houston, M., 2001, The role of esterin processed alfalfa saponins in reducing cholesterol. *J. AmericanNutr. Assoc.*,3: 6-15.

Doijode, S. P., 1975, Effect of growth regulators on growth and yield of Garden pea (*Pisum sativum* L.). *Mysore J. Agric. Sci.*, 11(1): 114.

El-Naggar, H. A. A. M., El-Naggar, N. M., andIsmaiel, 2009, Effect of phosphorus application and gibberellic acid on the growth and flower quality of (*Dianthus caryophyllus* L.). *American-Eurasian J. Agric. Environ. Sci*., 6: 400-410.

Emongor, V., 2007, Gibberlic acid (GA_3) influence on vegetative growth, nodulation and yield of cowpea (*Vigna unguiculata* L.). *J. Agronomy*, 6: 509-517.

Fatima, Z., Bano, A., Sial, R., and Aslam, M., 2008, Response of chickpea to plant growth regulators on nitrogen fixation and yield. *Pakistan J. Bot.*, 40(5): 2005-2013.

Francis, G., Kerem, Z., Makkar, H. P. and Becker, K., 2002, The biological action of saponins in animal systems: a review. *Br. J. Nutr*., 88: 587-605.

Hassanpouraghdam, M. B., Asl, B. H. and Khalighi, A., 2011, Gibberellic acid foliar application influences growth, volatile oil and some physiological characteristics of lavender (*Lavandula officinalis* C.). *Rom. Biotech. Lett*., 16(4): 6322-6327.

Iqbal, S., Ahmad, M.,Zaffar, G., Ahmad, F. and Dar, A. E., 2018, Alfalfa (*Medicago sativa* L), a valuable source of forage/fodder crop under cold arid conditions of Ladakh (Jammu and Kashmir). *Res. J. Chem. Envt. Sci.*,6(4): 74-84.

Khalak, A., 1989, Seed yield of Lucerne (*Medicago sativa* L.) varieties at different times of sowing and levels offertilizer. *M. Sc. (Agri.) Thesis*, Univ. of Agri. Sci., GKVK, Bengaluru.

Kumari, S. and Umesha, K., 2018, Influence of plant growth regulators on yield and economics of cultivation of Kalmegh (*Andrographis paniculata*Nees.). *Int. J. Chem. Stud.*, 6(6): 1317-1319.

Mishriky, J. E., 1990, Response of celery (*Apium graveolens* var. Dulce) to foliar application ofgibberelic acid (GA_3). *Bull. Faculty Agric. Cairo Univ.*, 41: 777–784.

Mortensen, A., Britton, G., Liaaen-Jensen, F., and Pfander, H., 2009, Supplements in: carotenoids: nutrition and health. *Birkhauser Verlag Basel*.,5(4): 67-82.

Nandre, D. R., Navandar U. O., and Archan D. W., 2009, Effect of growth regulators on growth, flowering and yield of china aster. *The Asian J. Hort*., 4(1):50-51.

Panse, V. G. and Sukhatme, P. V., 1967, Statistical methods for agricultural workers. *Indian Council Agric. Res. Pub.*, New Delhi, p.155.

Sharma, A., and Jain N. A., 2016, Study on effect of gibberellic acid on seed germination of urad bean. *Int. J. Curr. Microbiol. App. Sci.*, 5(4): 347-350.

How to cite this article:

Manju Prasada, D. P., V. P. Singh, Y. C. Vishwanath, S. M. Prasanna, Vijayamahantesh, Jameel Jhalegar and Vijayakumar B. Narayanpur. 2021. Performance of Plant Growth Hormones on Yield Characteristics of Alfalfa (*Medicago sativa* L.) under Northern Dry Zone of Karnataka. *Int.J.Curr.Microbiol.App.Sci.* 10(03): 875-884.
doi: https://doi.org/10.20546/ijcmas.2021.1003.110