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The effect of irrigation and nitrogen levels on nutrient content and uptake in grain amaranth (*Amaranthus hypochondriacus* L.) and soil Nutrient status after harvest

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Abstract
A field experiment was conducted at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari to study the effect of irrigation and nitrogen levels on Grain Amaranth (*Amaranthus hypochondriacus* L.). The treatments consisted combinations of four levels of irrigation *viz.,* 30 DAS (I_1), 30 DAS + 60 DAS (I_2), 30 DAS + 60 DAS + 75 DAS (I_3) and 0.8 IW: CPE (I_4) and three levels of nitrogen *ie.,* 50% RDN (N_1), 75% RDN (N_2) and 100% RDN (N_3). Nitrogen, Phosphorus and Potassium content in grain and straw were determined by Modified Kjeldahl's method, Vanadomolybdo phosphoric acid colorimetric method and Flame photometric method, respectively. Nutrient content was multiplied by yield to calculate nutrient uptake (kg ha^{-1}). Available N, P_2O_5 and K_2O were determined by alkaline permanganate method, Olsen's method and Flame photometric method, respectively. Fertilization with 100% RDN had a significant effect on nitrogen content in grain and straw, while P and K content remained non-significant. Irrigation and Nitrogen levels had a significant effect on nutrient uptake. Significantly higher nutrient uptake was observed under 30 DAS + 60 DAS + 75 DAS (I_3) and 100% RDN (N_3). The available soil N, P2O5 and K2O remained non-significant.

Keywords: Irrigation, nitrogen, nutrient, amaranth, *Amaranthus hypochondriacus* L.

Introduction
Grain amaranth (*Amaranthus hypochondriacus* L.) belongs to the family Amaranthaceae. The genus Amaranthus includes other species of grain type amaranth, *viz. A. peniculatus*, *A. cruentus* and *A. caudatus*. The grain types of amaranthus are thought to be of central American origin. Grain amaranth reached the pinnacle of its popularity as a staple crop during the *Mayan* and the *Aztec* periods in central America. These were introduced to the old world during the 19th Century by European settlers.

Grain amaranth is a potential upcoming subsidiary food crop, considered by many as crop of the future. Certain attributes, like it's higher productivity potential added with substantial quantities of minerals, carbohydrates, fats and proteins comparable with any of the improved cereals, have aroused great interest in development of grain amaranth as a cultivated crop (Desai *et al.,* 2013) [2]. Its input requirements are seemingly much lower than that of any other cereal. Amaranth is a quick growing multipurpose crop suitable for poor soils of semi-arid and seasonal wet areas. This crop is highly resistant to extreme stress conditions. Grain amaranth is a potential upcoming subsidiary food crop, considered by many as crop of the future (Chitla *et al*., 2021) [2]. Certain attributes, like higher productivity potential added with substantial quantities of minerals, carbohydrates, fats and proteins are comparable with any other important cereals.

Grain amaranth assumes special significance because of its C_4 - pathway indicating high productivity. It is highly nutritious with higher protein and lysine contents than almost any other cereal (Rana *et al*., 2017) [10]. Amaranth, as a grain crop, thus seems extremely versatile in climatic adaptation. It seems ideally suited to alternating wet and dry climates where the crop can be planted under warm and moist conditions and can a006Cso with stand both drought and low temperature during its later stages.

Water, a scarce and precious commodity, wants judicious use to achieve the goal of increased production per unit volume of water applied. The right time of application of adequate amount of irrigation water with minimum losses is essential for efficient and economic utilization of

water resources for higher production (Shinde *et al.*, 2014) [11]. This is especially when water supply is either limited or very costly. Presently, irrigation to grain amaranthus is provided in advertently without understanding the irrigation requirement of the crop. Precisely, one way of increasing production per unit volume of water is to irrigate at critical stages of crop growth, which are more sensitive to water application. Scheduling of irrigation for grain amaranth at various critical growth stages, *i.e.*, from early vegetative growth to grain filling, can record beneficial effects under various agro climatic conditions. The scheduling of irrigation for grains amaranth, so far, has been restricted to climatic approach (IW/CPE ratio), as a close relationship has been established between the rates of consumptive use and evaporation (Prihar *et al.*, 1974) [9].
Among various other agronomic factors known to augment crop yield, fertilizer management plays a vital role in increasing crop productivity. Out of the three major plant nutrients used as fertilizers, nitrogen ranks first practically all over the world. Nitrogen plays an important role in the synthesis of chlorophyll as well as amino acids, which form the building units of protein and thus contribute to the growth of the plant (Madagoudra *et al*., 2021a) [5]. It also helps in early establishment of leaf area capable of photosynthesis and increase root development to enable more efficient use of inadequate supply of nutrients and soil moisture. Significant increase in amaranth seed yield with fertilizer application has been reported (Hauptli and Jain, 1978 and Bressani *et al.*, 1987) [3, 1]. Since long, grain amaranth has been cultivated as a marginal crop using local varieties and very little or no fertilizers. This is the main reason for extremely low yield of this crop. So far, not much information has been available on judicious fertilizer use for getting higher yield in the irrigated conditions of the state. In view of the above, this experiment was planned to determine the optimum nitrogen levels and irrigation scheduling for maximum growth and yield of grain amaranth.

Material and Methods

A field experiment was conducted during *rabi* 2017 at college farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari to assess the effect of irrigation and nitrogen levels on growth, yield attributes, yield and economics of grain amaranth. The soil of the experimental site was clayey in texture (62.17%), medium in organic carbon (0.56%), low in available nitrogen (188 kg ha^{-1}), medium in available phosphorus (35 kg ha^{-1}) and available potassium (344 kg ha^{-1}). The soil reaction was slightly alkaline (pH 8.15) with normal electrical conductivity.
In all, twelve treatment combinations, consisting of four levels of irrigation *viz.*, 30 DAS (I_1), 30 DAS + 60 DAS (I_2), 30 DAS + 60 DAS + 75 DAS (I_3) and 0.8 IW: CPE (I_4) and three levels of nitrogen *i.e.*, 50% RDN (N_1), 75% RDN (N_2) and 100% RDN (N_3) were evaluated in factorial randomized block design with three replications. The RDF for the grain amaranth is 60-40-00 NPK kg ha^{-1}. Before the present experiment, Pearl millet was grown in the field and harvested in June and kept fallow prior to grain amaranth sowing. The grain amaranth variety GA-2 was sown on November 22, 2017. The required quantity of clean seeds was mixed with soil by making for uniform sowing of seeds. The sowing was done manually in previously opened furrows at a depth of 2 cm. Seeds were covered properly with the soil and a light irrigation was given carefully in each plot after sowing.
Bio-compost at 5t ha^{-1} was applied on the experimental field before sowing and mixed well. Nitrogen was applied as per the treatments. Common application of 40 kg P_2O_5 ha^{-1} was made as basal. The sources of nitrogen and phosphorus were urea and single super phosphate, respectively. Total four irrigations were given during the crop period. During the study, the following chemical studies were conducted.

Nutrient content (%)

Chemical studies were carried out by taking representative grain and stover samples at harvest were drawn from each net plot for chemical analysis. They were oven dried at 65±° C for 24 hours and then powdered by using willey type grinding mill. Finally, the grinded material was utilized for estimation of N, P and K.
Nitrogen, phosphorus and potash content in grain and stover was estimated by using following method on per cent dry weight basis as per method of modified Kjeldahls, Vanadomolybdo phosphoric acid yellow colour and Flame photometric method, respectively as described by Jackson (1973) [4].

Table 1: Nutrient analysis methods of plant sample

Nutrients	Method	Reference
Nitrogen (%)	Modified Kjeldahl’s method	Jackson (1973) [4]
Phosphorus (%)	Vanadomolybdo phosphoric acid colorimetric method	Jackson (1973) [4]
Potassium (%)	Flame photometric method	Jackson (1973) [4]

Nutrient uptake (kg ha^{-1})

The nutrient uptake values of nitrogen (N), phosphorus (P) and potassium (K) by maize grins worked out using the following formula.

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient content (\%) x Yield (kg ha}^{-1}\text{)}}{100}$$

Nutrient status of soil (kg ha^{-1})

Representative soil samples from each plot were collected for chemical analysis. The samples were dried and powdered by mechanical grinder and passed through 2 mm sieve. The samples were analysed in respect of available nitrogen (N), phosphorus (P_2O_5) and potassium (K_2O) of soil before sowing and after harvest of the crop by following standard methods.

Table 2: Nutrient analysis methods of soil sample

Nutrients	Method	Reference
Available Nitrogen	Alkaline permanganate method	Subbiah and Asija, (1956) [14]
Available Phosphorus	Olsen’s method	Olsen *et al.* (1954) [7]
Available Potassium	Flame photometric method	Jackson (1973) [4]

Results and Discussion

The results of the present study as well as relevant discussion have been summarized under following heads:

Nutrient content (%)

Data presented in Table 3 indicated that different irrigation levels did not found any significant difference in case of nutrient content in grain and stover of amaranth. While, significantly highest N content in grain and stover (1.68 and 0.97%, respectively) was obtained when the crop was fertilized with N_3 (100% RDN). Moreover, significantly the lowest N content in grain and stover (1.53 and 0.85%, respectively) was recorded with N_1 (50% RDN). P and K content in grain and stover failed to exert its significant effect. The present findings are on the lines of the findings of Desai *et al.* (2013) [2].

Nutrient uptake

Data on nutrients (N, P and K) uptake by grain and stover of grain amaranth are presented in Table 4 indicated that effect of varying irrigation levels on uptake of nutrients by grain and stover were found significant. Significantly higher N, P and K uptake by grain (14.86, 3.39 and 7.00 kg ha^{-1}, respectively) and stover (22.66, 7.65 and 41.47 kg/ha, respectively) were recorded with treatment I_3 (30 DAS + 60 DAS + 75 DAS) being at par with I_4 (0.8 IW: CPE) and I_2 (30 DAS + 60 DAS). Whereas, the lowest N, P and K uptake by grain (11.25, 2.56 and 5.22 kg ha^{-1}, respectively) and stover (17.31, 5.87 and 34.15 kg ha^{-1}, respectively) were registered under treatment I_1 (30 DAS). The present findings are in line with the findings of Desai *et al.* (2013) [2].

A perusal of data in Table 4 indicated that nutrients uptake by grain and stover were influenced significantly due to different nitrogen levels. Significantly higher N and K uptake by grain (15.24 and 6.92 kg ha^{-1}, respectively) was recorded under treatment N_3 (100% RDN) being at par with N_2 (75% RDN) in case of K uptake, while, P uptake by grain was found non-significant. Moreover, significantly the highest N, P and K uptake by stover (23.35, 7.69 and 41.43 kg ha^{-1}, respectively) were recorded with treatment N_3 (100% RDN). The lowest uptake of N, P and K by grain and stover were registered under treatment N_1 (50% RDN). The present findings are on the lines of the findings of Madagoudra *et al*., (2021b) [6] in maize and Solanki *et al.* (2016), Parmar and Patel (2009) [12, 8] in grain amaranth.

Nutrient status of soil after harvest (kg ha^{-1})

The data presented in Table 5 revealed that available N, P_2O_5 and K_2O in soil after harvest of crop were found non-significant due to different levels of irrigation and nitrogen.

Table 3: Effect of irrigation and nitrogen levels on nutrient content in grain and stover of grain amaranth

Treatments	Nutrient content (%)					
	Grain			Stover		
	N	P	K	N	P	K
A. Irrigation (I)						
I_1: 30 DAS	1.54	0.34	0.71	0.85	0.29	1.67
I_2: 30 DAS + 60 DAS	1.59	0.35	0.74	0.86	0.30	1.69
I_3: 30 DAS + 60 DAS + 75 DAS	1.63	0.37	0.77	0.94	0.32	1.73
I_4: 0.8 IW: CPE	1.61	0.36	0.75	0.95	0.31	1.71
S.Em ±	0.03	0.43	0.02	0.04	0.01	0.04
CD (P = 0.05)	NS	NS	NS	NS	NS	NS
B. Nitrogen (N)						
N_1: 50% RDN	1.53	0.35	0.72	0.85	0.29	1.67
N_2: 75% RDN	1.57	0.35	0.74	0.87	0.30	1.70
N_3: 100% RDN	1.68	0.36	0.76	0.97	0.32	1.73
S.Em ±	0.03	0.01	0.02	0.03	0.01	0.04
CD (P = 0.05)	0.09	NS	NS	0.10	NS	NS
C. Interaction (I x N)						
CD (P = 0.05)	NS	NS	NS	NS	NS	NS
CV %	7.05	13.5	9.50	12.8	12.0	7.52

Table 4: Effect of irrigation and nitrogen levels on nutrient uptake in grain and stover of grain amaranth

Treatments	Nutrient uptake (kg ha^{-1})					
	Grain			Stover		
	N	P	K	N	P	K
A. Irrigation (I)						
I_1: 30 DAS	11.25	2.56	5.22	17.31	5.8	34.15
I_2: 30 DAS + 60 DAS	12.80	2.80	5.96	18.09	6.2	35.46
I_3: 30 DAS + 60 DAS + 75 DAS	14.86	3.39	7.00	22.66	7.6	41.47
I_4: 0.8 IW: CPE	14.38	3.25	6.64	21.69	6.9	39.06
S.Em ±	0.73	0.22	0.38	1.31	0.3	1.76
CD (P = 0.05)	2.15	0.64	1.11	3.84	1.0	5.17
B. Nitrogen (N)						
N_1: 50% RDN	12.02	2.81	5.67	17.72	5.9	34.59
N_2: 75% RDN	12.71	2.89	6.03	18.75	6.4	36.58
N_3: 100% RDN	15.24	3.29	6.92	23.35	7.6	41.43
S.Em ±	0.64	0.19	0.33	1.13	0.3	1.53
CD (P = 0.05)	1.87	NS	0.96	3.32	0.9	4.48
C. Interaction (I x N)						
CD (P = 0.05)	NS	NS	NS	NS	NS	NS
CV %	16.54	21.68	18.2	19.68	15.8	14.10

Table 5: Available nutrient in soil as influenced by irrigation and nitrogen levels of grain amaranth

Treatments	Available nutrient after harvest (kg ha^{-1})		
	N	P_2O_5	K_2O
A. Irrigation (I)			
I_1: 30 DAS	164.9	46.61	338.1
I_2: 30 DAS + 60 DAS	173.3	48.54	351.9
I_3: 30 DAS + 60 DAS + 75 DAS	184.6	51.79	369.9
I_4: 0.8 IW: CPE	182.7	50.45	367.2
S.Em ±	6.53	1.36	8.81
CD (P = 0.05)	NS	NS	NS
B. Nitrogen (N)			
N_1: 50% RDN	168.2	47.17	343.4
N_2: 75% RDN	175.3	49.44	355.7
N_3: 100% RDN	185.5	51.43	371.1
S.Em ±	5.65	1.17	7.63
CD (P = 0.05)	NS	NS	NS
C. Interaction (I x N)			
CD (P = 0.05)	NS	NS	NS
CV %	11.10	8.25	7.40

Conclusion
Significantly the highest N content in grain and stover were observed when crop fertilized with 100% N (N_3) while, P and K content in grain and stover remained non-significant. N, P and K uptake by grain and stover were recorded significantly higher under treatment 100% RDN (N_3) except P uptake by grain. Irrigation and different levels of nitrogen reflected non-significant results for available N, P_2O_5 and K_2O status of soil after harvest of grain amaranth. **5.**

References

1. Bressani R, Gonzalez JM, Elias LG. Effect of fertilizer application on the yield, protein and fat content, and protein quality of raw and cooked grain of three amaranth species. Qualities Plantarum Plant Foods for Human Nutrition 1987;37:59-67.
2. Chitla SS, Patel HH, Madagoudra YB, Lokesh R, Terin P. The effect of irrigation and nitrogen levels on growth, yield and economics of grain amaranth (*Amaranthus hypochondriacus* L.). The Pharma Innovation Journal 2021;10(9):1146-1149.
3. Desai LJ, Patel MM, Chaudhari PP, Shaukat A, Patel JK. Influence of integrated nitrogen management on nutrient content and uptake of grain amaranth (*Amaranthus hypochondriacus* L.). Journal of Soils and Crops 2013;23(1):53-60.
4. Hauptli H, Jain SK. Biosystematics and agronomic potential of some weedy and cultivated amaranths. Theoretical Applied Genetics 1978;52:177-185.
5. Jackson ML. “Soil Chemical Analysis”. Prentice Hall of India Pvt. Ltd; New Delhi 1973,183-192.
6. Madagoudra YB, Ardeshna RB, Chaithanya J, Lokesh R. The effect of rate and time of nitrogen application on growth, yield attributes, yield and economics of summer maize (*Zea mays* L.). The Pharma Innovation Journal 2021a;10(5):1156-1159. DOI: 10.22271/tpi.2021.v10.i5o.6365.
7. Madagoudra YB, Chaithanya J, Terin P, Lokesh R. Effect of Rate and Time of Nitrogen Application on Nutrient Content and Uptake in Summer Maize (*Zea mays* L.) and Soil Nutrient Status after Harvest. International Journal of Economic Plants 2021b;8(2):057-061. DOI: 10.23910/2/2021.0410a.
8. Olsen SR, Col CV, Watanabe FS, Dean LA. Estimation of available phosphorus in soil by extraction with sodium bicarbonate. USDA Circ. No. 939 1954.
9. Parmar JK, Patel JJ. Effect of nitrogen management on growth and yield of grain amaranthus (*Amaranthus hypochondriacus* L.). An Asian Journal of Soil science 2009;4(1):106-109.
10. Prihar SS, Gajiri PR, Narang RS. Scheduling of irrigation of wheat using pan evaporation. Indian Journal of Agriculture Science 1974;44(9):567-571.
11. Rana KN, Patel GJ, Desai CK, Akbari MP. Quality of amaranthus (*Amaranthus hypochondriacus* L.) and soil properties influenced by irrigation scheduling based on critical growth stages and levels of iron. Journal of Pharmacognosy and Phytochemistry 2017;6(5):101-103.
12. Shinde SA, Patange MJ, Dhage SJ. Influence of irrigation schedules and integrated nutrient management on growth, yield and quality of *rabi* maize (*Zea mays* L.). International Journal of Current Microbiology and Applied Sciences 2014;3(12):828-832.
13. Solanki RP, Solanki RM, Patel HA, Odedra RK, Prajapati VS, Dodia VD. Effect of scheduling irrigation and organic manure on yield attributes, nutrient content and uptake of *rabi* amaranthus (*Amaranthus paniculatus* L.) in Saurashtra region. International Journal of Science, Environment and Technology 2016;5(4):2076-2083.
14. Subbiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soil. Current Science 1956;25(8):259-260.