Plant Archives Vol. 19, Supplement 2, 2019 pp. 1499-1503 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF PLANTING DATES AND LEVELS OF NITROGEN FERTILIZER IN THE GROWTH AND YIELD OF GREEN AND DRY FORAGE FOR GUINEA GRASS *PANICUM MAXIMUM CV. MOMBASA*

Shaimaa Ibrahim Al-Rifai[1] and Mohammed Abdul-Raza Abdul Wahid[2]

[1]Field Crop Department, Agriculture College, University of Al-Muthanna, Iraq.

[2]Field Crop Department, Agriculture College, University of Basrah, Iraq.

Abstract

A field experiment was carried out at the Second Agricultural Research Station that belongs to the collage of Agriculture / Al-Muthanna University, located on the Euphrates River in Al-Bandar village, south-west of Al-Muthanna Province (800 m away from Samawah City Center/ Al-Muthanna Province) during the summer season 2017-2018, to study the effect of three planting dates (5/4, 20/4 and 5/5) and five levels of nitrogen fertilization (0, 100, 150, 200 and 250 kg N ha^{-1}) and their interaction in the growth and yield of green and dry forage for Guinea grass *Panicum maximum cv. mombasa*, for five cuttings. The experiment was applied by factorial experiments using complete randomized block design (RCBD) with three replicates. The results showed significant superiority of the third date (5/5) in giving highest means in plant height at first cutting and the number of tillers m^{-2} at second and fourth cutting, and the highest yield of green forage for the first, second, third and fourth cuttings, and dry weight. The second date (20/4) gave highest plant height at the fifth cutting and the number of tillers, and the yield of green and dry forage at the fifth cutting. As for the effect of nitrogen fertilization, the fertilization level gave highest plant height and highest number of tillers was (424 and 610) tiller m^{-2} for the first and fifth cuttings respectively, and green forage yield was (27.7, 23.0 and 57.2) ton. ha^{-1} for the first, second and fifth cutting respectively, dry forage yield (7.54 and 18.18) ton.ha^{-1} at the first and fifth cuttings.. The level of fertilizer 200 kg N h^{-1} gave the highest height at the first and second cuttings was 143.9 and 144.8 cm respectively, and the highest number of tillers was 432 tiller m^{-2}, for the second cutting, and yield of green forage at the fifth cutting was 57.2 ton. h^{-1}. For the effect of the interaction between the dates of planting and fertilization levels had a significant effect on the yield of green forage at the third cutting where the treatment of planting date 5/5 with the level of fertilization 200 kg N. h^{-1} gave the highest average for green forage yield (70.0) ton ha^{-1}

***Keywords*:** Planting dates, nitrogen fertilizer, growth, yield, green, dry forage, Guinea grass *Panicum maximum*, *cv. mombasa*.

Introduction

The Guinea grass *Panicum maximum cv. mombasa* is a perennial forage crop that belongs to Gramineous family from the C4 plant (Aliscioni *et al*., 2003). It is cultivated spread in tropical and subtropical regions and found in high temperatures areas where, thus it has a fundamental economic importance in many tropical countries such as East and South Africa, Australia, South America, the Virgin Islands, and Hawaii and also grows in almost all the tropics areas (Duke, 1983). It has a strong root, which makes it resistant to drought and has a large and dense vegetative part where the height of the plant reach (1-2) m with a large number of basil tillers and leaves stay green until the end of winter, making it a high green forage yield, and it is also well adapted with a wide range of different environmental conditions (Brown, 1980, Gibbs Russell *et al*., 1990). The plant is characterized by the green and dry forage yield and chewy by the animals. It is therefore, widely cultivated in pastures and for the good claims, where the amount of green forage reaches yearly 150 ton.ha^{-1} and each 100 g of forage contains 5.9 g of protein, 1.6 g of fat, 81.9 g of carbohydrates, 10.6 g of ash and carotene from 24 to 39 mg. As well as containing many vitamins and other essential mineral elements for the growth of animals when fed (C.S.I.R, 1976; Gohl, 1981 and Botha, 2000). Odedire and Abegunde (2014) in reported in Nigeria that the Ponecam content of crude protein, raw fiber, ether and ash extracted are 10.76, 28.96, 6.88, 10.47 % respectively. In order to increase the yield of cultivated area of green forge have a good quality and palatable, there are a range of processes and agricultural technologies that must be taken care and developed, for example, the introducing of good forages crops to be cultivated successfully in the area conditions as well as selection the ideal planting date where the date of cultivation is considered from the processes that must be taken care of it One of the most important factors depends on the establishment of plants because it is affected by the surrounding climatic conditions, and directly related with intensity and quality of the light and the length of the light period as well as its impact in the temperatures that differ from one date to another, which in turn impact on the physiological process that occur by plant, and based on the appropriate temperature for seeding and the thermal units required for flowering, is determining the best date of planting and most suitable cultivation of crop growth, Duke (1983) demonstrated the possibility of growing ponecam in the spring and early summer, Vassey *et al*. (1985) observed that dry forage yield was 8.5, 6.5 and 4.5 ton.ha^{-1} when blue panic were grown in April, May, and June respectively. Curran *et al*. (2012) reported that early planting at the beginning of the May give the highest green forage yield, Choi *et al*. (2016) when they studied the effect of six planting dates of varieties of millet found the decline in the average height of the plant at the delay of the planting date to 25 July. Obaid (2018) reported the possibility of planting the blue panic in early April, giving the green and dry forage 112.56 and 11.80 ton. ha^{-1}, respectively. As well as the processes that increase the production efficiency using the appropriate amounts of fertilizer, especially nitrogenous, which plays a key role in improving the growth of plants as one of the major elements needed by the plant through the participation and entry, mainly in the synthesis of proteins, chlorophyll and protoplasm, nuclear acids, plastids, mitochondria and energy compounds, as well as its active role in promoting the division, expansion and elongation of living cells (Abo-Dahi and Yunis, 1988; Hopkins, 1999). Al-Alawi and Al-Waka'a (2009) noted that the increase in nitrogen fertilization of millet from (80-240) kgN.ha^{-1} increases the number of leaves and the green forage yield, Pereraira *et al*. (2012) found an increase in the production of

dry matter of the Guinea grassand the ratio of leaves to stems by increasing the level of fertilization to 320 kg $N.h^{-1}$ compared to other levels. Garcez Neto (2012) showed an increase in the number of branches and weight of leaves, stems and biomass of the Ponecam roots when using high levels of nitrogen fertilizer. Buzetti *et al.* (2015) recorded highest yield of total dry forage of 2.329 ton. ha^{-1} as average of five cuttings. Since the Guinea grass of newly introduced crops to Iraq and there is no studies about this crop, this study was conducted, which aims to determine the appropriate planting date and determine the level of appropriate nitrogen fertilizer, which gives the highest yield of green forage in quantity and quality.

Materials and Methods

A field experiment was carried out at the Agricultural Research Station that belongs to the collage of Agriculture / University of Al-Muthanna, located in Al-Bandar village, southwest of Al-Muthanna province, which is 800 meters away from the city center, and during the summer planting season (2017 - 2018) in soil with silty loam texture to study the effect of three sowing dates (5/4, 20/4 and 5/5) and five levels of nitrogen fertilization (0, 100, 150, 200, 250 $kg.N.ha^{-1}$) Which gave N_0, N_1, N_2, N_3 and N_4 codes respectively and interaction among them in the growth and yield of green and dry forage for the Guinea grass *Panicum maximum cv. mombasa.* The experiment was applied according to the method of factorial experiments using complete randomized block design (RCBD) with three replicates. The soil of the experiment was prepared by two orthogonal tillage using rotary plow, after the puddling process was carried out. The land was divided according to the design used to 2 m long and 2 m wide. The seeds were first planted in cork plates according to the planting dates of the study and then transferred after 20 days of planting for each date. Each experimental unit consisted of four lines, 50 cm the distance between line and another and 25 cm the distance between. The experiment was fertilized with phosphate fertilizer was added with 100 kg / h of P_2O_5 in one batch before planting. Nitrogen fertilizer was added according to the study treatments and in the form of urea (46% nitrogen), the first addition post planting and the rest of the additions were added after each two cutting. The first cutting was taken after 70 days of planting, while the other cuttings were taken on a height of 120 cm (Onyeonagu *et al*., 2012 and Hassan *et al*., 2015). Random samples of field soil were taken before planting at a depth of 0-30 cm for conducting some chemical and physical analysis their results are shown in table (1) according to Page et al (1982).

Some chemical and physical traits of soil experiment before planting

Trait		Value	Unit
Chemical traits	Soil reaction (pH)	7.5	—
	Electrical conductivity (E.C)	7.14	$Ds.m^{-1}$
	Available N	10	Microgram gm^{-1}
	Available P	14.14	Microgram gm^{-1}
	Available K	186	Microgram gm^{-1}
Physical traits	Sand	20.13	mg Kg^{-1}
	Silt	21.54	mg Kg^{-1}
	Clay	58.33	mg Kg^{-1}
	Soil texture	sandy mixture	

The following traits were studied:

Plant height (cm): The plants height was measured by using the metric ruler for 10 plants taken randomly from each experimental unit for all replicates.

Number of tillers (tiller m^{-2}): Number of tillers calculated form a wooden box 60*60 cm taken randomly and then converted to a square meter of each experimental unit for all replicates.

The green forage yield ($t.ha^{-1}$): calculated for each cutting of wooden board (60*60 cm) that was cutting from each plate randomly and then the average of green forage yield was converted from (kg m^{-2}) to ($ton.ha^{-1}$).

The dry forage yield ($t.ha^{-1}$): calculated for each cutting based on total drying process for green forage yield and then the average of was converted from (kg m^{-2}) to ($ton.ha^{-1}$).

The statistical analysis was carried out using the GenStat program and the means of the treatments used in the study were compared using the least significant difference at the probability level 0.05 (Al-Rawi and Khalaf Allah, 1980).

Results and Discussion

The results of table (2) indicated that the planting dates were significantly affected in the plant height trait, where the third date 5/5 at the first cutting gave the highest height of 137.0 cm, while the second date 20/4 was superior than fifth cutting and gave the highest average for plant height of 138.7 cm, which significantly differed than the third date, because of the appropriate temperature for growth at planting at the late date where the biological effectiveness at the best states, which led to an increase in growth and division of cells, and it is elongation, thus increase in plant height and this is consistent with the Obaid (2018). Also, for the effect of nitrogen fertilization was more significantly in this trait and at all cuttings, as the results indicate that the increase in the fertilization levels resulted in an increase in plant height, where the fertilization level 200 kg $N.ha^{-1}$ gave the highest mean for height of 143.9 and 144.8 cm for the first and second cutting respectively, which did not differ than the fertilization level 250 kg $N.ha^{-1}$, which gave the highest average of 155.7, 149.2 and 145.3 cm for the third, fourth and fifth cuttings respectively, while the comparison treatment was recorded lowest highest for all cuttings, and this may be due to positive effect of nitrogen at early stages of growth in the number and elongation of internodes through the division and expansion of cells. In addition to the effect of nitrogen in the growth regulator indole acetic acid that necessary for elongation of cells (Taiz and Zeiger, 2002). The results of table (3) show that the planting dates have significantly affected the number of tillers m^{-2} for the last four cuttings except the first cutting, where the last date 5/5 gave the highest average for this trait (451 and 680) tiller m^{-2} for the second and fourth cuttings respectively, while the second date gave the highest average of (406 and 739) tiller m^{-2} for the third and fifth cuttings respectively and differed significantly than the rest of the dates and for different cuttings. This may be due to the fact that the conditions at the second and third dates of the temperature were appropriate to increase the number of tillers. As for the effect of nitrogenous fertilization, it also had a significant effect at the first, second and fifth cuttings in this trait, where the level of fertilization N_4 (250 kg N. ha^{-1}) gave the highest average (424 and 610) tiller m^{-2} for the first and second cuttings respectively, while the level of N_3 (200 $kg.N.ha^{-1}$) at the second cutting gave an average was 432 tiller m^{-2}. This may be due to the role of the nitrogen element in increasing the growth of the roots, which are directly linked with the increase the number of tillers, as well as that nitrogen act for the increase the formation of cytokines that responsible for reducing the top dominance in plants, which increases the plant's ability to branching (Attia and Wahib, 1989 and Attia and Jaddou'i, 1999).

Table 2 : Effect of the planting date and nitrogen fertilization and their interaction in the average of plant height (cm)

Cuttings	Planting Dates	Nitrogen fertilization (kg N.ha^{-1})					Average dates
		N_0	N_1	N_2	N_3	N_4	
First	5/4	100.6	124.9	116.6	139.9	136.6	123.7
	20/4	105.1	118.1	126.1	145.8	144.5	127.9
	5/5	127.8	127.0	141.1	146.2	143.2	137.0
	Fertilization mean	111.2	123.3	127.9	143.9	141.4	
	LSD. 0.05	For dates	7.92	For fertilization	10.23	For interaction	N.S
Second	Planting dates	N_0	N_1	N_2	N_3	N_4	Average dates
	5/4	116.5	130.4	125.4	144.7	144.9	132.4
	20/4	118.5	116.4	131.6	150.0	149.3	133.2
	5/5	128.9	132.5	136.4	139.6	139.3	135.3
	Fertilization mean	121.3	126.4	131.1	144.8	144.5	
	LSD. 0.05	For dates	N.S	For fertilization	10.91	For interaction	N.S
Third	Planting dates	N_0	N_1	N_2	N_3	N_4	Average dates
	5/4	118.8	130.8	134.5	146.8	148.5	135.9
	20/4	119.8	126.1	146.1	157.2	149.4	139.7
	5/5	127.1	131.4	136.4	154.2	169.1	143.6
	Fertilization mean	121.9	129.5	139.0	152.7	155.7	
	LSD. 0.05	For dates	N.S	For fertilization	10.99	For interaction	N.S
Fourth	Planting dates	N_0	N_1	N_2	N_3	N_4	Average dates
	5/4	121.3	136.9	139.2	150.7	135.2	136.7
	20/4	125.8	134.3	132.8	137.5	157.8	137.7
	5/5	126.2	137.1	136.4	151.5	154.5	141.1
	Fertilization mean	124.4	136.1	136.1	146.6	149.2	
	LSD. 0.05	For dates	N.S	For fertilization	9.75	For interaction	N.S
Fifth	Planting dates	N_0	N_1	N_2	N_3	N_4	Average dates
	5/4	111.6	134.5	142.7	145.6	149.0	136.7
	20/4	127.7	124.7	143.0	144.7	153.3	138.7
	5/5	115.2	112.6	133.4	135.2	133.7	126.0
	Fertilization mean	118.2	123.9	139.7	141.9	145.3	
	LSD. 0.05	For dates	7.91	For fertilization	10.21	For interaction	N.S

Table 3 : Effect of the planting date of and nitrogen fertilization and the interaction between them in the average number of tillers m^{-2}

cuttings	Planting dates	Nitrogen fertilization (kg N.ha^{-1})					Average dates
		N_0	N_1	N_2	N_3	N_4	
First	5/4	194	209	350	398	426	315
	20/4	152	339	320	289	412	302
	5/5	198	238	384	322	435	315
	Fertilization mean	181	262	351	336	424	
	LSD. 0.05	For dates	N.S	For fertilization	107.6	For interaction	N.S
Second	Planting dates	N0	N1	N2	N3	N4	Average dates
	5/4	227	248	478	466	550	394
	20/4	171	239	244	296	245	239
	5/5	405	471	488	536	353	451
	Fertilization mean	268	319	403	432	383	
	LSD. 0.05	For dates	83.4	For fertilization	107.6	For interaction	N.S
Third	Planting dates	N0	N1	N2	N3	N4	Average dates
	5/4	267	262	294	256	259	267
	20/4	318	517	419	415	359	406
	5/5	311	297	303	472	436	364
	Fertilization mean	299	359	339	381	351	
	LSD. 0.05	For dates	94.0	For fertilization	N.S	For interaction	N.S
Fourth	Planting dates	N0	N1	N2	N3	N4	Average dates
	5/4	375	399	407	308	513	401
	20/4	373	316	380	361	363	359
	5/5	510	412	941	853	685	680
	Fertilization mean	419	376	576	507	520	
	LSD. 0.05	For dates	121.2	For fertilization	N.S	For interaction	N.S
Fifth	Planting dates	N0	N1	N2	N3	N4	Average dates
	5/4	284	389	485	434	481	414
	20/4	461	797	790	843	802	739
	5/5	398	317	566	519	548	470
	Fertilization mean	381	501	614	599	610	
	LSD. 0.05	For dates	85.1	For fertilization	109.9	For interaction	N.S

It was noted from the results of table (4) that the dates of planting had a significant effect on the average of green yield, where the last planting date 5/5 giving highest mean for this trait at the first fourth cuttings, giving the highest average (29.1, 23.1, 47.1 and 43.7 t.ha^{-1}) for the first, second, third and fourth cuttings respectively, while at the fifth cutting, the date 20/4 was superior in the average of this trait, which gave 57.7 ton.ha^{-1}. The reason of superiority of cultivated plants yield at 5/5 due to the ideal growth of plants during this period in which the climatic factors of the temperature and the light, which were suitable for increase in plant height and formation of tillers, which reflected positively on the growth of the plant and therefore an increase in the yield of green forage and this is consistent with what was observed by Obaid (2018) and Vassey *et al*. (1985). From the results of the same table, it was showed that nitrogen fertilization also had a significant effect on this trait, where we note that by increasing levels of nitrogen fertilization, the yield of green forage increases, where the level of fertilization 250 kg N. ha^{-1} was gave highest average of 27.7 and 57.2 ton.ha^{-1} at the first and fifth cuttings respectively, which did not differ significantly than the fertilization level of 200 kg N.ha^{-1}, which gave averages (22.7, 23.1 and 53.5) tons.ha^{-1} at the first, second and fifth cuttings, and also gave highest mean for this trait at the third cutting of 43.3 tons ha $^{-1}$, and the increase in the yield of green forage at these levels is due to the role of nitrogen in increasing growth through its role in many biological events and its entry into a large number of plant components and its living organisms (Abo-Dahi and Yunis, 1988 and Hopkins, 1999), as well as its role in the division, expansion and elongation of cells which leads to the formation of a total vegetative and root be able to benefit greatly and the optimal utilization from the production elements including nutrients and light, thus increase in the synthesis and accumulation of dry matter in plants, which reflected positively on the increase the yield of green forage (Al-Saadi, 2000 ; Al-Alawi and Al-Waghaa, 2009 and Maral *et al*., 2013). As for the effect of the dual interaction between planting dates and nitrogen fertilization, it was significant at the third cutting, where the treatment of planting date 5/5 with the fertilization level 200 kg N. ha^{-1} gave highest mean of the green forage yield was 70.0 ton.ha^{-1} respectively. This superiority may due to the increase in the number of tillers due to the favorable climatic conditions for planting at this date and to the role of the high nitrogen element at this level of nitrogen fertilization.

Table 4 : Effect of the planting date and nitrogen fertilization and the interaction between them in the average of green forge yield (t.ha^{-1})

Cuttings	Planting dates	Nitrogen fertilization (kg.N.ha^{-1})					Average dates
		N_0	N_1	N_2	N_3	N_4	
First	5/4	7.3	9.5	18.9	19.1	22.1	15.4
	20/4	8.8	13.7	18.1	17.9	16.7	15.0
	5/5	17.3	20.6	31.8	31.2	44.4	29.1
	Fertilization mean	2.76	3.51	6.08	5.82	7.54	
	LSD. 0.05	For dates	5.72	For fertilization	7.38	For interaction	N.S
Second	Planting dates	N_0	N_1	N_2	N_3	N_4	Average dates
	5/4	9.6	11.4	21.5	21.4	24.6	17.7
	20/4	11.8	13.7	14.5	19.7	20.5	16.1
	5/5	19.3	22.8	21.6	28.1	23.7	23.1
	Fertilization mean	13.5	16.0	19.2	23.1	23.0	
	LSD. 0.05	For dates	5.39	For fertilization	6.96	For interaction	N.S
Third	Planting dates	N_0	N_1	N_2	N_3	N_4	Average dates
	5/4	17.4	19.4	22.7	23.2	22.8	21.1
	20/4	16.3	27.5	37.0	36.6	22.8	28.0
	5/5	39.1	27.9	37.9	70.0	60.4	47.1
	Fertilization mean	24.3	25.0	32.5	43.3	35.4	
	LSD. 0.05	For dates	8.99	For fertilization	11.61	For interaction	N.S
Fourth	Planting dates	N_0	N_1	N_2	N_3	N_4	Average dates
	5/4	15.3	22.4	19.9	18.4	27.3	20.7
	20/4	33.1	29.0	37.1	26.4	44.3	34.0
	5/5	39.0	29.4	53.2	55.9	41.1	43.7
	Fertilization mean	29.1	26.9	36.7	33.5	37.6	
	LSD. 0.05	For dates	10.22	For fertilization	N.S	For interaction	N.S
Fifth	Planting dates	N_0	N_1	N_2	N_3	N_4	Average dates
	5/4	24.5	48.6	61.0	49.3	57.4	48.1
	20/4	54.7	40.0	63.0	64.0	67.0	57.7
	5/5	38.9	28.1	45.9	47.2	47.4	41.5
	Fertilization mean	39.3	38.9	56.7	53.5	57.2	
	LSD. 0.05	For dates	9.15	For fertilization	11.81	For interaction	N.S

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