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RESPONSE YIELD AND SOME GROWTH PARAMETERS OF BREAD WHEAT TO NANO AND NITROGEN FERTILIZERS

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ABSTRACT

The experiment was conducted to evaluate the influence of Nano and nitrogen fertilizers on grain yield and some growth parameters of bread wheat. The field experiment was carried out at the farm of field crop department, College of Agricultural Engineering Sciences, University of Duhok. The experimental units included of Nano fertilizer and four levels of nitrogen fertilizer (0, 20, 30 and 40 Kg ha^{-1}). Each experimental units consisted of four rows for each varieties. The data analyzed according to factorial experiment in randomize block design with three replications. Results indicated that the significant response is obvious due to varieties, Holler variety was superior in leaf area (60.98cm^2), number of grain spike^{-1} (49.46) and spike length (11.05cm), while the nitrogen application exhibited a significant effect at nitrogen levels on all studied characters and the highest values for leaf area (64.65cm^2), total grain yield (5.0635 ton/ha) and 1000 grain yield (32.75gm) was recorded at rate 40 Kg ha^{-1}. For the interaction between Nano, nitrogen fertilizers and wheat varieties, the results indicated that the maximum values were recorded by Holler variety and 40 Kg ha^{-1} of nitrogen fertilizer, indicating that positive influence of nitrogen and Nano-fertilizer on yield, some growth parameters and grain yield were related to better performance of variety. For variation in agronomic efficiency (AE), the maximum value was recorded by Holler variety and also the results exhibited the highest value for grain yield response index (GYRI). The Holler cultivar was more than Adana-99 and the values ranged 15% to 36% compare with 7% to 16% for Adana-99.

KEY WORD: Nano fertilizer, Nitrogen, Bread wheat, Yield components.

INTRODUCTION

Bread wheat (*Triticum estivum L.*) is one of the most important cereal crops of the world and is a staple food for about one third of the world's population (Hussain *et al.,* 2002). The low of mean production in Iraq and Kurdistan Region due to using varieties of wheat with low yielding and in adequate nitrogen and rainfall.

Nitrogen is the important nutrient for growth and production of common wheat that effects on the plant growth and increases grain yield. Many researchers reported that the nitrogen application increased total grain yield of wheat (Fresew *et al*., 2018; Hussain et al., 2017; Beyenesh *et al.*, 2017 and Amanel *et al*., 2002), however the increase of common wheat yield depend on the inadequate management of nitrogen fertilization and other factors such as varieties and rainfall.

Nitrogen is constituent of protein, enzymes, co-enzymes, nucleic acid, phytochromes and chlorophyll; it plays an important role in the biochemical processes to the plant, therefore, it's one of the most required nutrients by wheat crops (Wendling *et al.,* 2007; Kutman *et al.,* 2011). Nitrogen deficiency by the plant with a great impact on grain yield and it components. (Heinemann *et al.,* 2006).

Wheat crop grow under a wide range of environmental conditions in Iraq. Plant breeder aim to develop wheat cultivars that consistently have high yield in a variety of environments. Wheat cultivars exposed to different soil types, soil fertility, moisture levels, temperatures and cultural practices. The adaptability of a variety is usually tested by the degree of its interaction

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with different environments. A variety or genotype considered to be more adaptive or stable if it has a high mean yield with low degree of fluctuation in yielding ability grown over diverse climatic conditions. Nitrogen consider as a key factor of yield and quality in the cereals. Numerous studies indicate that the nitrogen fertilization can increase both grain yield and grain protein content. Morsy *et la*., 2018, demonstrated that the interaction of nano fertilizer and nitrogen levels had a significant effect on FUE in the two growing season.

Morsy *et al*., 2018, indicated that the Nano fertilizer concentration and nitrogen levels had significant effects on most yield component. Nano technology is the most novel field of the twenty-one century and nano technology such as using nano scale particles is expected to play a vital role in developing improved systems for increasing the ability of crops to absorb nutrients (Rameshaiah and Japllavi, 2015). Nano fertilizer enhance growth parameters, plant height, leaf area, number of leaves per plant, dry matter production, chlorophyll production, rate of photosynthesis which result more production and translocation of photosynthesis to different parts of plant compare with traditional fertilizers (Ali and Al-Juthery, 2017 and Singh *et al*., 2017), therefore, the aim was to determine the extent effect foliar feeding of Nano-fertilizer and nitrogen fertilizer in yield and some parameters of wheat varieties growth and yield.

MATERIALS AND METHODS

The experiment consist of two wheat cultivar (Holler and Adina-99) was carried out at the farm of College of Agricultural Engineering Sciences/ Duhok University in silty clay soil **(Table 1),** at latitude 36°: 51ˉ: 40.9˭ N, longitude 42°: 51ˉ: 54.6˭ E, and at elevation approximately 510 meter above the sea level, this study included the growth and yield of wheat by foliar application (Nano-fertilizer) containers, (N 6%, P 3%, K 17%, Fe 4%, Zn 4%, Mn 2%, Cu 0.5%, B 0.5%, Mo 0.1%, Ca 1%, Mg 3% and S 6%), at rate 2gm L^{-1} to all experimental units without control before the flowering stage, and nitrogen fertilizers with different levels (0, 20, 30 and 40 Kg ha^{-1}). Each experimental unit consisted of four rows with 3 m length at a distance of 30 cm between lines with 5 cm in depth, the distance between each experimental units is 40 cm and seeds were sown at (11/12/2019) with rate seed of 120 Kg/ ha* nitrogen applied (0, 20, 30 and 40 Kg ha^{-1}) using urea (46%) at the tillering stages. While, the foliar application process was conducted at the start of flag leaf stage. All management practices for soil such as (land, soil preparation and tillage) and for plant like (pesticides or herbicides) were done as required. The data were recorded on plant height, flag leaf area, spike length, number of seed $Spike^{-1}$, 1000-seeds weight, seed spike weight and grain yield ton/ha. The rainfall and air temperature climatic data of the experiment field location, during growing season 2019-2020, were obtained from the meteorological Sumel station presented in **(Table 2)**. Analysis of variance were analyzed using factorial experiment with randomize block design with three replication and Duncan Multiple Range Test (DMRT) using to compare between means of the treatment at 0.01 and 0.05 probability by using SAS 9.1 version software.

Agronomic Efficiency (AE)

Agronomic Efficiency (AE) as a nitrogen physiological parameters was calculated to Delogu *et al.,* 1998 using the following equation:

$$AE = \frac{\text{Grain yield at N treatment} - \text{Grain yield at control (zero N)}}{\text{Applied N at treatment}}\ (\text{Kg grain/Kg N})$$

Grain Yield Response Index (GYRI)

Grain Yield Response Index (GYRI) was calculated for each cultivars according to Fageria and Barbosa Filo (1981) using the following equation:

$$GYRI = \frac{\text{Grain yield under high N level} - \text{Grain yield under control N level}}{\text{high N level} - \text{control N level}}$$

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Table (1): Some physical and chemical properties of the studied soil before planting.

Soil property	Unit	Depth (0-30)cm
pH	(1:1) extract	7.95
EC	dS m^{-1}	0.48
Available N	mg Kg^{-1}	109.35
Available P	mg Kg^{-1}	4.93
K^{+}	soluble cations (mmolc L^{-1})	0.19
Ca^{+2}		1.62
Mg^{+2}		1.06
Na^{+}		0.64
CO_3^{-2}	soluble anions (mmolc L^{-1})	trace
HCO_3^{-}		2.28
Cl-		0.52
$CaCO_3$	g Kg^{-1}	215.3
O.M	g Kg^{-1}	16.5
CEC	Cmolc. kg^{-1}	31.42
Sand	g Kg^{-1}	73.857
Silt	g Kg^{-1}	427.781
Clay	g Kg^{-1}	498.363
Soil texture		Silty clay
Bulk density	g cm^{-3}	1.37

Table (2): Average of the rainfall and air temperature climatic data of the experiment field location.

years	months	rainfall mm	temperature C°	
			Max.	Min.
2019	Oct.	3	30.8	18.2
2019	Nov.	30	22.1	9.3
2019	Dec.	107	14.6	6.9
2020	Jan.	89.5	10.6	4.1
2020	Feb.	76	11.7	4.3
2020	Mar.	310	18.6	9.8
2020	Apr.	55	19.8	10.7
2020	May	16.5	21.2	11.6

RESULTS AND DISCUSSION

ANOVA Table revealed that the cultivar (Holler) had highly significant effect on leaf area, plant high and spike length, significant effect for seed number $spike^{-1}$ and non-significant effect on grain yield and 1000 grain weight, while the nitrogen level had highly significant effect for all characters. The interaction of cultivars and nitrogen fertilization level had highly significant effect on leaf area and significant for seed number $spike^{-1}$ and spike length, whilst, the other characters were not significant effect **Table 3**. These results confirm the findings of (Fersew *et al.*, 2018; Dere, 2017 and Tomado *et al*., 2015).

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Table (3): Analysis of variance for yield and its components under different levels of nitrogen fertilizer.

Source	Mean S							
	DF	Leaf area cm2	Plant height (cm)	Total weight in ton ha^{-1}	Weight of 1000 seeds (gm)	Seed number/ spike	Seed weight/ spike (gm)	spike length cm
Block	2	0.498	0.042	0.0438	5.071*	2.85	0.0099	0.185*
Varieties (A)	1	66.634**	486.00**	0.0159	1.98	29.04*	0.0029	0.454**
Fertilizer (B)	3	122.65**	1016.11**	3.9240**	20.84**	297.97**	0.3090**	13.343**
A*B	3	24.99 **	21.45**	0.2466	0.82	25.75*	0.0097	0.182*
Error	14	0.47	9.33	0.0997	1.096	4.77	0.012	0.044
Total	23							

, * significant at 0.05 and 0.01 respectively

Varietal differences

Mean values for seven characters are shown in **Table 4.** The mean performance of the two varieties. The variety Holler was superior in leaf are (60.98 cm^2), number of grain spike^{-1} (49.46) and spike length (11.05). While, the Adana-99 variety was performance in plant height (82.17 cm). The results in the same table exhibited that no significant between the varieties in grain yield, 1000 grain weight and grain weight spike^{-1}. The results indicating that the differences between Holler and Adana-99 was due to, the varieties variability in most characters may be affected not only physiological traits but also by the nitrogen supply in soil and also, this implies varieties differ in absorption and utilization of nitrogen depend on the structure of genotypes. Varietal differences in yield components among wheat cultivars were obtained by (Aleum *et al.*, 2019; Debre, 2017 and El-Metwally and Suady, 2009).

Table (4): Mean of varieties of bread wheat on yield and yield components under different nitrogen levels.

Varieties	Means						
	Leaf area cm^2	Plant height cm	Total weight in ton ha^{-1}	Weight of 1000 seeds (gm)	Seed number/ spike	Seed weight/ spike (gm)	spike length cm
Holler	60.98 a	73.17 b	4.4355 a	30.83 a	49.46 a	1.51 a	11.05 a
Adana-99	57.64 b	82.17 a	4.3840 a	31.39 a	47.26 b	1.49 a	10.78 b

Mean bearing different letter within each column different significantly at 0.05 level.

Effect of Nitrogen Fertilization

Data presented in **Table 5**, exhibited the effect of nitrogen levels on seven characters of bread wheat varieties. The results showed that a significant effect of all nitrogen levels on all studies characters comparison with control and also, the rate 40 Kg ha^{-1} clearly, the highest values for leaf area (64.65 cm^2), plant height (88.33 cm), total grain yield (5.0635 ton/ha), 1000 grain weight (32.75g), number of grain spikr-1 (65.97), weight of grain spike^{-1} (1.71g) and spike length (12.52) respectively, followed by the rate 30 Kg ha^{-1} and recorded high mean values comparison with the rate of 20 Kg ha^{-1}. From the results in **Table 5** indicated that the increase in yield and some studied characters,

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the variation with increase nitrogen, the rate up to adequate level might be due to the role of nitrogen in increasing the leaf area and promote photosynthesis efficiency which promote dry matter production and increase yield and yield components. These results are in accordance with report of (Lopez-Bellido *et al.,* 2005; Saudy *et al.,* 2008; Nemat *et al.,* 2013 and Fresew *et al.,* 2018).

Table (5): Effect of nitrogen levels on yield and yield components on bread wheat cultivars.

Treatments	Means						
	Leaf area cm^2	Plant height cm	Total weight in ton ha^{-1}	1000 seeds Weight (gm)	Seed number/ spike	Seed weight/ spike (gm)	spike length cm
Control	54.39 d	59.50 c	3.2453 c	28.51 c	40.32 d	1.18 c	9.18 d
N 20 kg	57.03 c	77.17 b	4.5097 b	31.06 b	45.83 c	1.52 b	10.23 c
N 30 kg	61.18 b	85.67 a	4.8205 ab	32.10 ab	50.32 b	1.60 ab	11.72 b
N 40 kg	64.65 a	88.33 a	5.0635 a	32.75 a	56.97 a	1.71 a	12.52 a

Mean bearing different letter within each column different significantly at 0.05 level.

Effect of Interaction

Generally, increasing nitrogen up to 40 Kg ha^{-1} with each tested cultivars showed in **Table 6**, maximum values for leaf area, plant height, grain yield, 1000 grain weight, number of grain $spike^{-1}$, weight of grain $spike^{-1}$, and spike length. From the same table the Holler variety was superior in leaf area ($61.17cm^2$), grain yield (5.192 ton/ha), number of grain $spike^{-1}$ (57.43) and grain weight $spikt^{-1}$ (1.77g), at rate of 40 nitrogen level. While, the Adana-99 variety was performance in plant height (91.33cm), 1000 grain weight (33.21g) and spike length (12.57cm) at rate of 40 nitrogen levels. From the result in the same table, the Holler variety was response to the different nitrogen levels in most characters compare with Adana-99 variety, indicating that the positive effect of nitrogen fertilization levels on grain yield and yield components were related to better performance of grain yield components and the response of variety may be effected not only physiological traits but also by nitrogen supply in soil, similar results were obtained by (Ali and Al-Juthey 2017; Beyensh *et al.*, 2017 and Izzat *et al.*, 2020).

Table (6): Effect of interaction between nitrogen levels and bread wheat cultivars on yield and yield components.

Combination N*V		leaf area cm^2	plant high cm	Total weight in ton ha^{-1}	weight of 1000 seeds gm	Seed number. $spike^{-1}$	seed weight $spike^{-1}$ gm	spike length cm
Holler	N0	54.84 e	52.33 f	2.9838 c	28.58 c	38.77 e	1.19 c	9.33 e
	N20	57.01 d	72.67 d	4.7088 b	31.05 b	48.40 c	1.54 b	10.60 c
	N30	62.89 b	82.33 c	4.8575 ab	31.39 ab	53.23 b	1.55 b	11.80 b
	N40	69.17 a	85.33 bc	5.192 a	32.29 ab	57.43 a	1.77 a	12.47 a
Adana-99	N0	53.94 e	66.67 e	3.5069 c	28.45 c	41.87 de	1.18 c	9.03 e

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N20	57.04 d	81.67 c	4.3106 b	31.08 b	43.27 d	1.50 b	9.87 d
N30	59.47 c	89.00 ab	4.7836 ab	32.816 a	47.40 c	1.64 ab	11.63 b
N40	60.18 c	91.33 a	4.935 a	33.216 a	56.50 ab	1.66 ab	12.57 a

Mean bearing different letter within each column different significantly at 0.05 level.

Agronomic Efficiency

`Variation in agronomic efficiency (AE) appeared to result differences in two varieties using in this study **Table 7**. The maximum AE was exhibited with Holler, to mention that increase of nitrogen enhanced grain yield by 16% and 9% at second level 40 Kg nitrogen, while the Adana-99 appeared low AE for different levels of nitrogen and the value ranged 16% to 18% with adding and 30 Kg ha^{-1}. From the results at the same table, it showed be that genotypic variation in nitrogen efficiency could generally be attributed to high nitrogen uptake or in high nitrogen utilization by different varieties. It should be concluded that nitrogen level in the soil could be manipulated together with genetic diversity of the crop as a breeding tool for wheat cultivars development through improving nitrogen uptake or nitrogen utilization efficiency. These result are in good agreement with finding by (Saudy *et al.,* 2008).

Grain Yield Response Index

Grain Yield Response Index (GYRI) was calculate at zero and 40 Kg N ha^{-1} as low and high nitrogen levels respectively. Grain yield response index is an indication to the efficient of wheat cultivars for producing higher grain yield at low nitrogen and their response to increase nitrogen fertilizer rates accordingly, it is possible to classify wheat cultivars into four groups: **(1)** Efficient and Responsive (ER) that produce high grain yield at low as well as high rates of nitrogen fertilizer. **(2)** Efficient and not Responsive (ENR) that produce high grain yield at low nitrogen rate with lower response to increase nitrogen fertilizer than (ER). **(3)** Not Efficient but responsive (NER) that has low grain yield with response to increase nitrogen fertilizer; and. **(4)** Neither Efficient not Responsive (NENR) that has low grain yield with low response to increase nitrogen fertilizer. From the data in the **Table 6**, the GYRI for Holler cultivar was more than Adana-99 cultivar and the values ranged 15% to 36% compare with 7% to 16% for Adana-99 cultivar. Differences between two cultivars for GYRI were largely due to variation in utilization of accumulated nitrogen, but with high nitrogen rate they were largely due to variation in up take efficiency. The variety Holler was performance in (ER) and (GYRI) at different rate of nitrogen, this in fluctuation in grain yield due to genetic structure of cultivars in leaf area, plant height, number of leaves $plant^{-1}$ and yield components. This support with finding the nano fertilizer and nitrogen levels effect on yield of bread wheat (Saudy *et al.,* 2008; Nemat *et al.,* 2013 and Aleum *et al.,* 2019).

Table (7): Agronomic efficiency and grain yield response index for Holler and Adana-99 varieties.

Nitrogen levels	Varieties			
	Holler		**Adana-99**	
	AE	**GYRI**	**AE**	**GYRI**
20	**11%**	**5%**	**16%**	**7%**
30	**27%**	**20%**	**18%**	**14%**
40	**36%**	**36%**	**16%**	**16%**
Average	**25%**	**20%**	**17%**	**12%**

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CONCLUSION

The results of this study showed that the Nano and nitrogen fertilizers which were used for bread wheat production and have not reflected and also in this experiment, application of 2g/L of Nano fertilizer and 40 Kg ha^{-1} of nitrogen fertilizer caused high a variability of nitrogen nutrient for plant growth parameters and improved wheat crop productivity.

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رەنگڤەدانا بەرهەم و چەندین پیڤەرێن گەشەیا شینکاتیا گەنمێ نانی بۆ پەینێ نانو و پەینێ نایتروجینی

پوختە

ئەڤ ڤەکولینە ل زەڤی یێن تاقیکرنان ل کولیژا ئەندازیارییا چاندنێ ل زانکویا دهوکێ هاتینە ئەنجامدان، کو دڤێ ڤەکولینێ دا تاقیکرن لسەر پەینێ نانو و چەندین ئاستێن جودا ژ پەینێ نایتروجینی و کارتێکرنا وان لسەر گەشە و بەرهەمێ گەنمێ نانی هاتینە کرن، یەکەیێن تاقیکرنێ پێکهاتبوون ژ پەینێ نانو و چار ئاستێن پەینێ نایتروجینی (0،20،30، 40) کگم/ هێکتار. هەر یەکەکا تاقیکرنێ پێکهاتبوو ژ چار هێلان بۆ هەر جوینەکی بۆماوەیی (جینوتایپ). شروڤەکرنا ئەنجامان لدویف تاقیکرنێن جیهانی یا کەرتێن هەرەمەکی یێن تەڤگر ب سێ دووبارەبوویان هاتنە بریڤەبرن. ئەنجام ب ئەڤی ڕەنگی دیاربوون؛ هەبوونا جیاوازییێن ڕاماندار دناڤبەرا جوینانان دا و جینێ هەولێر د ساخلەتێ رووبەرێ روویێ بەلگی دا ب (60.9 سم2) و هژمارا تۆڤێ گولیێ (49.46) و درێژاهیا گولیێ (11.05سم) بسەرکەفت، بەلێ پا دیاربوو کو ب زێدەکرنا نایتروجینێ جیاوازی یێن بلند یێن راماندار دناڤبەرا ئاستێن جودا جودا پەیدابوینە. و کارتێکرنا ئاستێن راماندار لسەر هەر جوینەکێ تاقیکرن لسەر هاتیە کرن، و بلندترین بها یێ رووبەرێ روویێ بەلگی (64.65 سم2) و داهاتێ دندکان هەمیان

(5.0635 تە ن \ هێکتار) و بارستەیا هزار دندکان (32.72غم) ل ئاستێ 40 کگم/هیکتار هاتینە تومارکرن. بەلێ سەبارەت تێکهەلبوونێن دناڤبەرا پەینێ نانو و نایتروجینی و جویناندا چێبوین هینگێ بندترین بها بدەستکەفتینە بۆ جوینێ هەولێر لدەمێ ئاستێ 40 کگم/هێکتار کو ئەڤە نیشانە لسەر هندێ کو ئەڤی جوینی بەرسڤدانەکا بلند بۆ پەینێ نایتروجینی و پەینێ نانو هەبوو.

بەلێ ژ بۆ ڤەگهورێ شیانێن بەرهەمی (AE) ل وی دەمی بلندترین بها د جوینێ هەولێرێ داهاتیە تومارکرن، هەروەکی هەمان جوین بلندترین بها وەك نیشان لسەر بەرهەمێ دندکان (GYRI) تومارکری، کو ئەو بهایە گەلەك یێ بلندبوو دناڤبەرا 15% بۆ 36% بوو وەك هەڤبەرکرن دگەل جوینێ ئەدنە-99 ئەوێ کو رێژەیا وی دناڤبەرا 7% بو 16% یە.

شوکە پەیڤ: پەینێ نانۆ، پەینێ نایترۆجینی، گەنمێ ئاری، پێکهاتێن بەرهەمی.

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استجابة الحاصل وخواص النمو الخضري لحنطة الخبز لسماد النانو والسماد النايتروجيني

الخلاصة

أجريت التجربة لتقييم تأثيرسماد نانو ومستويات مختلفة من النيتروجين على حاصل نمو وبعض معاملات النمو حنطة الخبز. طبقت الدراسة في حقل تجارب قسم المحاصيل الحقلية, كلية الهندسة الزراعية جامعة دهوك, وكانت الوحدة التجريبية مكونة سماد نانو وأربعه مستويات من السماد النيتروجين (30,20,0 و40) كغم في الهكتار. لكل وحدة تجريبية زرعت تركيب وراثي في أربعه خطوط. جرى تحليل النتائج وفق نظام التجارب العاملية بتصميم القطاعات العشوائية الكاملة وبثلاثة مكررات. اظهرت النتائج وجود فروقات معنوية بين الاصناف وتفوق الصنف هولير في صفة المساحه الورقية (60.9 سم^2) وعدد البذور سنبله (49.46) وطول السنبله (11.05 سم), واظهرت اضافة النيتروجين فروقات عالية المعنوية بين المستويات المختلفة. وكان تأثير هذه المستويات معنوياَ على كل الصفات المدروسة وسجلت أعلى القيم لمساحه الورقية (64.65 سم^2), وزن البذور (5.0635 طن في الهكتار) ووزن الف حبه (32.72غم) عند مستوى 40 كغم في الهكتار.

اما بالنسبه لتداخل بين السماد نانو والنيتروجين والأصناف فقد كانت أعلى القيم قد سجلت من قبل الصنف هولير وعند معدل 40 كغم في الهكتار مما يدل على ان هذا الصنف كانت أستجابته عالية للسماد النيتروجين وسماد نانو. اما بالنسبة الى معامل كفاءه المحصول (AE) فأن أعلى القيم سجلت من قبل الصنف هولير, كما سجل نفس الصنف قيم عالية لدليل الحاصل البذور(GYRI) تراوحت بين 15% الى 36% بالمقارنة بالصنف أدنه-99 الذي سجل نسبة تراوحت بين 7% الى 16%.

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