IMPROVING ALGERIAN CEREAL PRODUCTION: WHERE AND HOW?

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Abstract

Cereal cultivation in Algeria is practised in different areas according to morphology and bioclimatic levels. In this way, cereal yields observed in these areas are not the same. Our study has been made in order to test if this difference is statistically significant but also to test the link between the yields and bioclimatic levels of cereal area. This study could help public authorities to make better decisions to improve cereal yields and so cereal production by targeting cereals with relatively high yields and revising areas with weak yields.

Keywords: cereal area, Cereal yields, Bioclimatic level, Department yield classification, Bioclimatic-Yield link

1 INTRODUCTION

Wheat production in Algeria is very irregular from a year to another but also from a cereal region to another.

Previous study showed that rainfall affects for a little this production. However, adopted cereal policy contributed significantly to improve it (Bouchafaa and Kherchi, 2013). Cereal productions and yields in Algeria are very different, which led us to try test if this difference is significant or not.

Also, we tried to test, at the same time, if geographical position and climate of the cereal region is linked to its cereal yields.

To do that, we first defined cereal zones in Algeria and their characteristics, which we present in the following paragraph.

2 DISTRIBUTION OF CEREAL AREAS IN ALGERIA

Algeria presents three main cereal zones grouped, according to their geographical positions as well as the cereal yields which they offer. They are distributed as represented in the figure 1 below, as follows:

a. A cereal zone with high potentialities (Z1): we find an average pluviometry superior to 500 mm /per year, with average yields 20 q / ha (plains of Algiers and Mitidja, the pond of Issers, valleys of Soummam and Oued El Kébir, valley of Seybouse). This zone covers a SAU of 400 000 ha among which less than 20 % is dedicated to cereal;

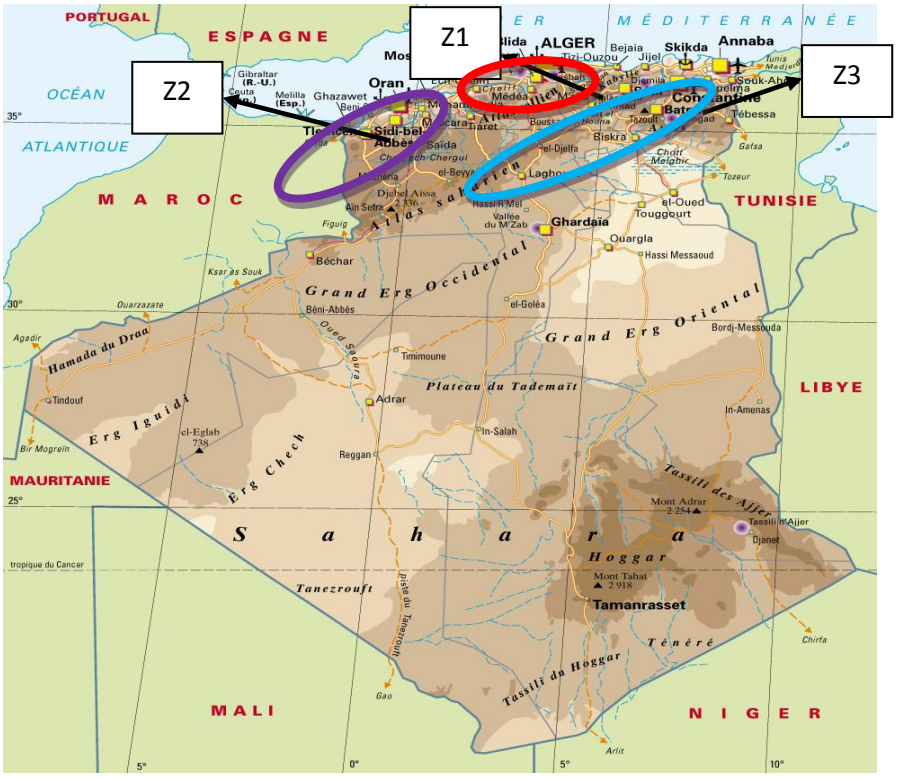
b. A zone with average potentialities (Z2): characterized by a pluviometry between 400 and 500 mm

per year, but subject to high climatic crises, the yields can vary from 5 to 15 q / ha (hillsides of Tlemcen, valleys of Chélif, massif of Médéa). The zone includes a SAU of 1'600'000 ha which less than half is reserved for cereal;

c. A zone with low potentialities (Z3): characterized by a semi-arid climate and situated in the east and western high plateaus and in the South of the Massif of Aurès. The average of the precipitation is lower than 350 mm a year. Here, the yields in grains are lower most of the time than 8 q/ha. The SAU of the zone reaches 4,5 millions of ha every year of which near half is allocated to cereal.

It is necessary to note very important points: ·

- These cultivated spaces are marked by a strong diversification according to agronomic and climatic conditions, because pluviometry variations explain with 50 % yields evolutions from a year to another ;
- In these areas cereal cultivation is difficultly substitutable.
- Compared with the world average, which is 29 q / ha for 2004, the yield on the Algerian wheat is only for the best 50s % of the world average. They are on average 10,5 q / ha, (they are among the weakest ones in the world). (Kellou, 2008)
- However, we attend these last years an improvement of these yields arriving at about 19 q/ha (MADR, on 2015) but they remain weak.



***Source**: established by ourselves from Kellou, 2008*

Figure 1 - Localization of the important cereal zones in Algeria

According to fig.1, Chehat, in 2006 bounded cereal cultivation in the northern part of the country and excluded cereal zones in Southern Algeria which nevertheless contributes to increase national production.

However, it is necessary to note that in the region of the Algerian South, cereal cultivation is practiced by irrigation; what lets us conclude that:

- cultural conduct is bad, for lack of technical mastery and qualified Workforce;
- margin of production of cereal declines further to the increase of production expenses and the decrease of yields;
- Weed invasion, water table rise and the salinization of sites;

- The practice of cereal cultivation of by pivot doesn't obey the agronomic rules with among others the ascendancy of the monoculture, and irrational exploitation of water resources. (Bedoui, 2006).

Therefore, for our study, we cannot take into account this region, since it is not "naturally cereal" especially as for a surface really cultivated 4.000 ha, only a few thousand tons of durum wheat are produced a year, with yields declining and striking as well as the northern part of the country a certain irregularity (Otmane and Kouzmine, 2013)

In what will follow, only obtained results concerning the northern part of Algeria will be considered; southern part's ones will be presented for comparison. We thus, will try to analyze the differences and compare productions and yields in cereal zones quoted by Chehat in 2006.

3 CLASSIFICATION RESULTS ACCORDING TO YIELDS

To conduct our study, we collected production and harvested surface data of durum and soft wheats by department from the Ministry of Agriculture and the rural development (MADR) in the whole national territory and on a period of 15 years going 2000 until 2014. We then deducted yields for both wheat and proceeded to an Analysis of Variance (ANOVA) with one criterion comparison which is «DEPARTMENT» without distinction between north and south parts (An essay of comparison was made according to this criterion and ended in no significant difference).

The following table N°1 presents results of the ANOVA realized, for the yields on durum wheat in Algeria.

Table N°1: results of the ANOVA for yields on durum wheat by Department in Algeria

	Tests Univariés de Significativité pour RENDEMENT (RDTblédurinternation Paramétrisation sigma-restreinte Décomposition efficace de l'hypothèse				
Effet	SC	Degr. de Liberté	MC	F	p
ord. origine	209091,5	1	209091,5	5764,541	0,00
wilaya	32178,1	44	731,3	20,162	0,00
Erreur	22851,4	630	36,3		

Source: *established by ourselves from MADR data, 2015*

Results we obtained reveal a significant difference, with an almost non-existent risk of error, between the yields on durum wheat in the departments of the country. This leads us to look for the similarities through the homogeneous groups proposed as follows:

1. The first one contains the departments of Biskra, Adrar, El-Oued and Ghardaïa of the South "Sahara" with non-pluvial cereal cultivation. It is characterized by a record average yield of 35 q/ha;

2. The second includes the departments of (Algiers, Blida, Boumerdès and Tipaza) besides a part of the departments of the South (Laghouat, Béchar, Ouargla, Tamanrasset) with an average of 23 q/ha,

3. In the third place, the median group includes departments of Mila, Jijel, Khenchela Bejaia, Bouira, Skikda, Tébessa, Guelma, El-Tarf, Aïn-Defla, Annaba, Constantine and Tizi-Ouzou with a yield(efficiency) on 17 q/ha,

4. The fourth group is constituted by the departments of Souk-Ahras, Relizane, Sidi-Bel-Abbès, Mostaganem, Tiaret, Sétif, Chlef, Naâma, Médéa with a yield of 14q / ha;

5. Finally, the last group with the weakest yield of 11 q/ha, contains the departments of Djelfa, Batna, Oran, Saïda, Tlemcen, Tissemsilt, M'Sila, Oum-El-Bouaghi, Bordj-Bou-Arreridj, Aïn-Temouchent and Mascara.

From these observations, we can advance the following conclusions:

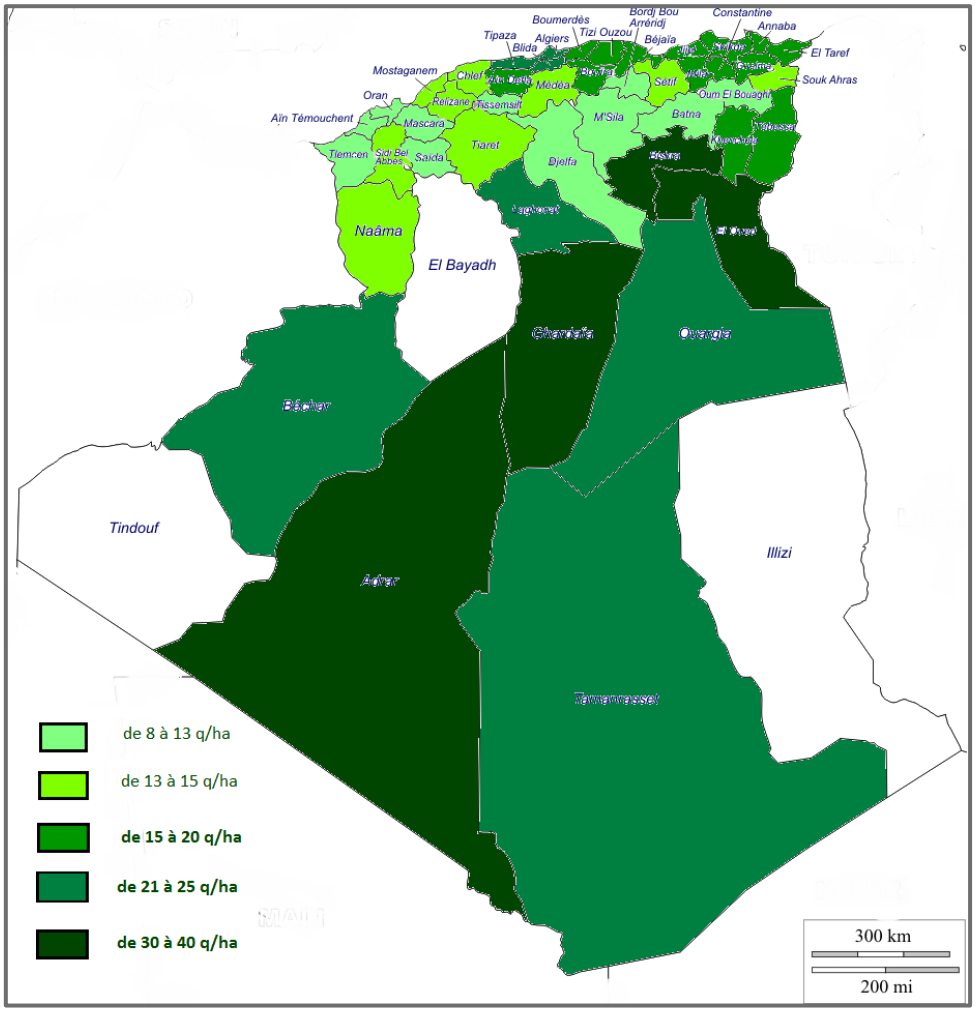
1. With all the efforts spread expended to intensify the cereal cultivation in the South, only four departments gave high yields reaching 40 q/ha;

2. Some Southern departments where the cereal cultivation is practised with pivot irrigation arrives hardly in the background in the same way as the first cereal zone of the North, classified by Chehat in 2006 and which preserved its place. In this group Tipaza is in the head with 25 q/ha;

3. The second cereal zone according to Chehat, 2006 is downgraded in the third zone with a backward drop

of yields which can hardly reach 13 q/ha.

We can show these various regions in the fig. 2 below:



Source: *established by ourselves from the MADR data, 2015*

Figure 2 - Distribution of the cereal zones according to yields on durum wheat

For the common wheat, the results were quite similar. The following ANOVA table indicates a significant difference in yields on common wheat in Algeria.

Table N° 2: Results of the ANOVA for yields on soft wheat by department in Algeria

	Tests Univariés de Significativité pour RENDEMENT (RDTblé tendr Paramétrisation sigma-restreinte Décomposition efficace de l'hypothèse				
Effet	SC	Degr. de Liberté	MC	F	p
ord. origine	150529,3	1	150529,3	4136,514	0,00
wilaya	19347,2	40	483,7	13,291	0,00
Erreur	20888,1	574	36,4		

Source: *established by ourselves from the MADR data, 2015*

In the same way as previously, we obtain a classification of the common wheat zones, according to yield, as follows:

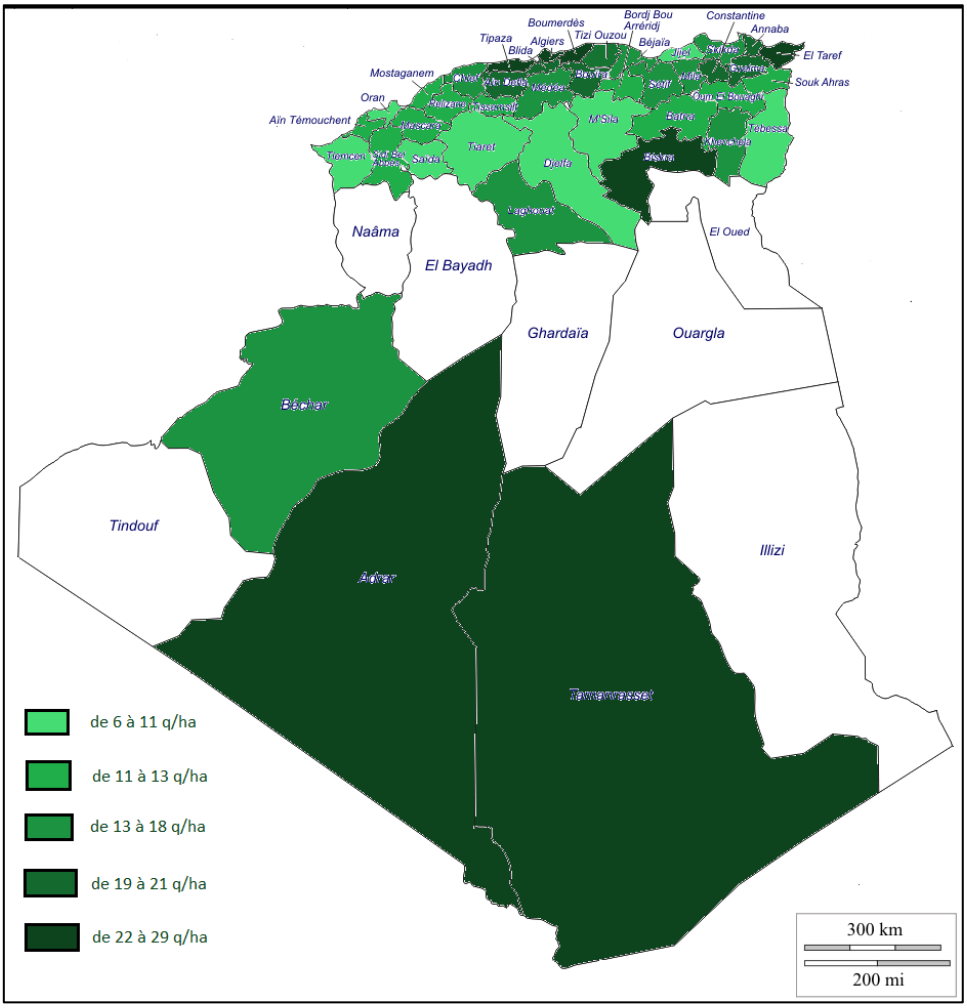
1. The first group concerns the departments of El-Tarf, Algiers, Boumerdès, Tamanrasset, Tipaza, Adrar and Tipaza. It is characterized by an average yield of 25 q/ha;

2. The second contains the departments of Annaba, Aïn-Defla, Guelma, Bouira, Constantine, Blida and Tizi-Ouzou with an average yield of 20 q/ha;

3. The third class includes the departments of Sétif, Chlef, Laghouat, Béjaïa, Mila, Médéa, Béchar, Skikda and Khenchela with an average yield of 15 q/ha,

4. The fourth zone is constituted by the departments of Sidi-Bel-Abbès, Tissemsilt, Batna, Aïn-Temouchent, Oum-El-Bouaghi, Relizane, Bordj-Bou-Ariridj, Mascara, Souk-Ahras and Mostaganem with an average yield(efficiency) on 12 q/ha;

5. Finally, the last zone consists on departments of Jijel, Djelfa, Tébessa, M'Sila, Oran, Saïda, Tlemcen and Tiaret with an average yield of 9 q/ha.



Source: *established by ourselves from the MADR data, 2015*

Figure 3 - Distribution of the cereal zones according to yields on common wheat

From the results obtained for both wheat we can say that cereal policies adopted during the last fifteen years (2000-2014), redrew cereal zones and showed that:

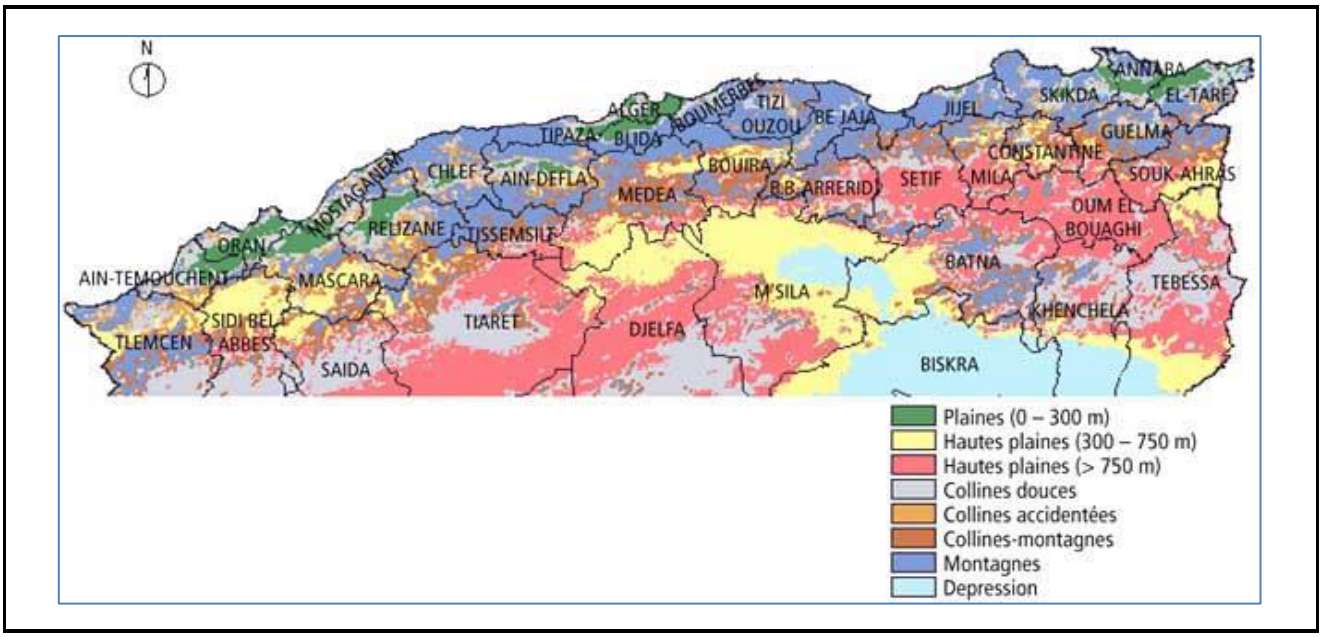
- cereal cultivation under pivot does not lead to the results hoped by the Program of Cereal Intensification (PIC);
- The application of the PIC through the National Program of Agricultural Development (PNDA) and the Agricultural and Rural Renewal (RAR) took out again the really potential zones of cereal cultivation;

- By eliminating the effect of southern departments, we can distribute northern Algeria in four cereal regions probably according to their geographical positions.
- Cereal yields are certainly, linked to the adopted policy but especially to the predispositions of regions to be distinguish by cereal cultivation.

It is so, imperative to study the effect of the -climatic characteristics of regions on the cereal yields. To encircle better this link, we are going to try to project cereal zones (North) on the bioclimatic and morphological cards of northern Algeria.

4 LINK BETWEEN CEREAL YIELDS AND GEOGRAPHICAL POSITION:

The fig. 4, below, distinguish the big ecological regions relatively well. In the North, we have the zone of culture (coast, the sub-littoral plains, the internal plains, the high plains, etc.), in the center the steppe zone and in the South the Sahara with its Oases.



***Source**: FAO, 2005.*

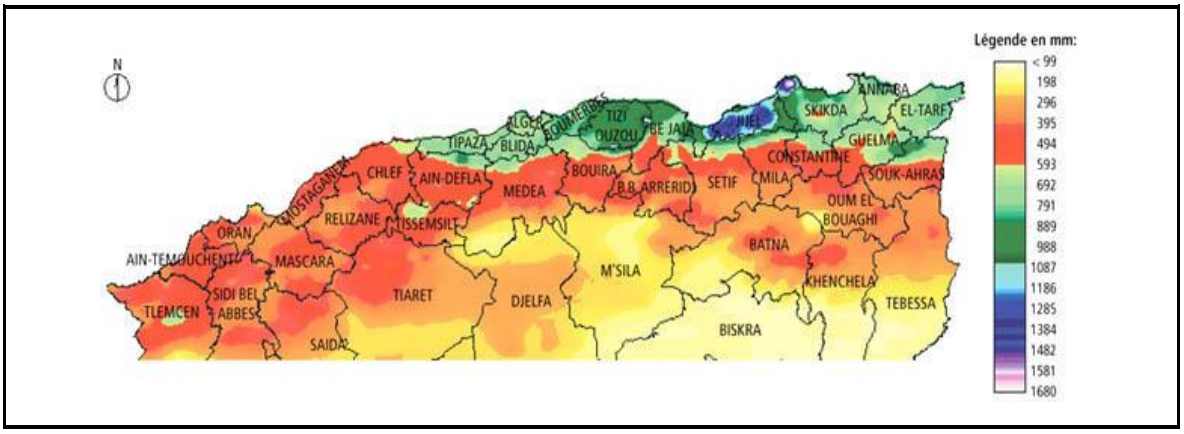
Figure 4 - morphological Classification of the North of Algeria

According to the bioclimatic classification of Emberger and Savage adopted in Mediterranean region, five floors of the Mediterranean bio climate were observed in Algeria: Saharan, dry, semi-arid, sub-wet and wet. They are subdivided into variants on the basis of the thermal thresholds of the temperature of the coldest month. We distinguish five variants from it for the vegetable production:

- cold Winter, in frosts during long periods, and the minimal temperature is between -3°C and 0°C;
- fresh Winter, in very frequent frosts, and the minimal temperature varies between 0°C and 3°C;
- moderate winter, in frequent frosts, and the minimal temperature is between 3°C and 5°C;;
- soft winter, in rare frosts, minimal temperature is between 5°C and 7°C;
- hot winter, in absent frosts, minimal temperature is between 7°C and 10°C.

Besides the averages of the temperatures in winter, the strong summer temperatures and drought brake vegetable production. This variation in the space depends on the latitude, on the continental character and on the relief. The height has an effect on the rainfall. Besides, a very clear asymmetry exists between hillsides. The facing north hillsides are the best watered, the facing south hillsides are the driest. (FAO, 2005)

Let us note that precipitations decrease from North to South and from East to West (fig. 5). Annual rainfall averages vary from less than 25 mm in the Saharan regions to more than 1'500 mm in certain localities of the North. This variation in the space depends on the latitude, on the continental character and on the relief.



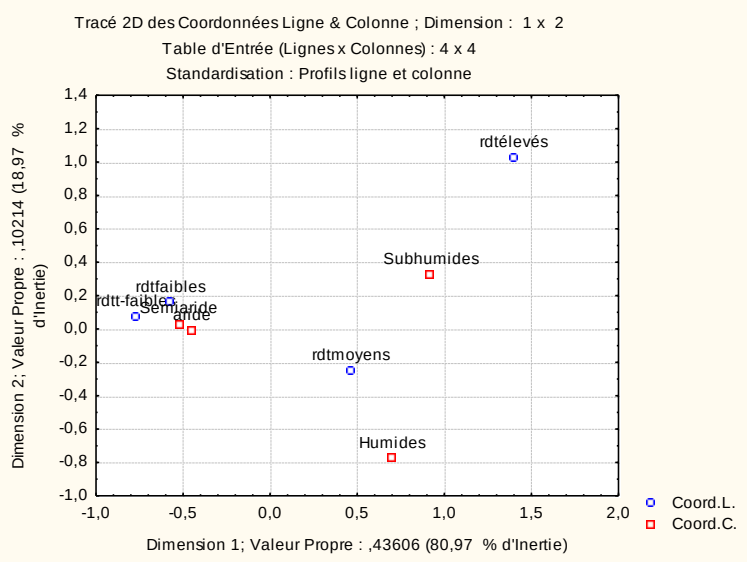
Source: *FAO, 2005*

Figure 5 - Distribution of the precipitation in the North of Algeria

After the projection made by three cereal zones, it emerges that:

- Zone (I) which promises the best yields turns out to be constituted for the major part, of plains, spreading out on a sub-wet bioclimatic level;
- Zones (II) and III) which present a less weak cereal potential spreads out on high plains of strong heights scattered on three bioclimatic levels with semi-arid ascendancy;
- Zone (IV) of the weakest cereal yields, spreads out on a semi-arid and dry bioclimatic level with morphological ascendancy for the high plains of low heights (between 300 and 750 m).

This is well confirmed by Factorial Correspondence Analysis (FCA) made in the aim of highlighting the link between the cereal yield and the bioclimatic level of regions of our study. The fig. 6 below shows the results obtained from statistical analysis and reveals a statistically significant link between both variables.



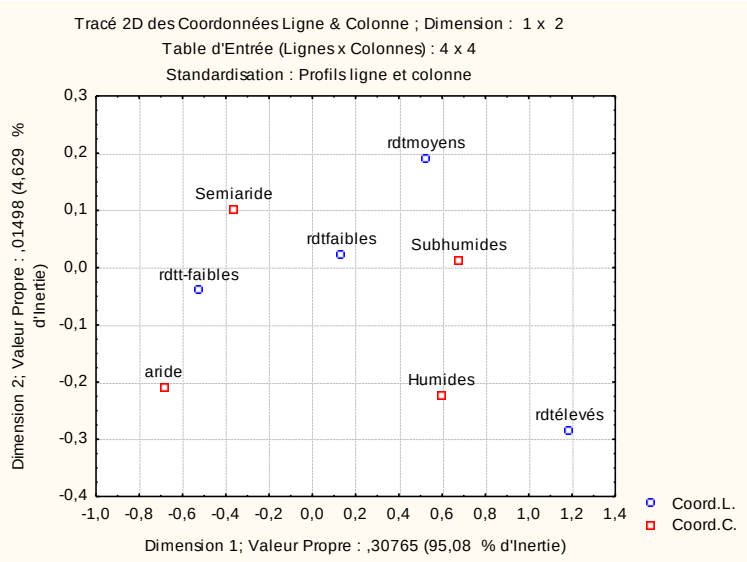
Source: *established by ourselves from the MADR data, 2015*

Figure 6- Representation of the link between yield on durum wheat and bioclimatic level

The fig. 6 above shows that there is a significant link between the cereal yield and the cereal region. We note that for durum wheat:

- weak and very weak yields are observed in the dry and semi-arid regions;
- Average yields dominate wet regions;
- the high yields are observed in sub-wet areas.

On the other hand, FCA made for the common wheat gives us another distribution of the cultural zones. Fig. 7 below presents the analysis results.



Source: *established by ourselves from MADR data, 2015*

Figure 7- Representation of the link between yield on soft wheat and bioclimatic level

Contrary to durum wheat, the zones of common wheat seem logically distributed according to the cereal regions following their bio-climatic levels. Indeed, we classify these zones by the following way:

- The very weak yields are noted in the dry regions;
- The weak yields dominate the semi-arid regions;
- The average yields are observed in sub-wet regions,
- Finally, the high yields characterize wet regions.

Let us note that our study did not take into account other considerations such as the know-how, technology of seeding and the cultivated varieties of wheat; it is probably why, the results we obtained seem quite paradoxical for durum wheat.

The climatic characteristics thus have an effect on the cereal yields because all cereal zones do not give the same yields. The test of link of these two variables confirms that they are significantly linked.

5 CONCLUSION

A study of the effect of the pluviometry led us to conclude that it doesn't explain alone wheat national production. Indeed this one affects for a little the results of the cereal campaign.

A classification of the cereal regions during the period 2000-2014 reveals a clear modification of the cereal geography in Algeria. The adoption of the PNDA and hard RAR where we put the accent on the PIC helped to take out again zones really in cereal potentialities.

This statistical analysis showed us that in spite of efforts expended in the southern part of the country, yields obtained aren't much higher than ones obtained in the first northern cereal zone.

The bioclimatic difference associated with the diversity of the climatic conditions conjugated to the adoption of new more ambitious policies give to birth a new classification of cereal zones per regions. The yields by zone are statistically, significantly different.

In priori, we found how this difference affects the cereal yields, but we cannot say that only the climatic conditions have an effect on the yields on wheat in Algeria. Indeed we detected an anomaly concerning the classification of the zones of durum wheat culture.

However, this study can help us decide where spreading efforts to get good results since the aim of our analysis is to find what could improve cereal yields in Algeria. So:

- First, it isn't recommended to practise cereal cultivation in the Southern part of Algeria,
- Particular attention must be paid to areas giving relatively high and average yields;
- know-how and the popularization must be stressed in areas giving weak yields;

In this way, we suggest pushing study farther to encircle real effects which make that yields remain weak and more surveys must be led to define real situation of cereal cultivation in Algeria.

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