Appraisal of the performance of peanut genotypes (*Arachis hypogaea* L.) from the ICRISAT collection in India

R. Bernard SAWADOGO1*, K. Marie-Laure GUISSOU1, M. Bertin ZAGRE2, S. NANKONE1 and Philippe SANKARA3

1Life and Earth Science Laboratory, Université Norbert ZONGO, BP: 376 Koudougou, Burkina Faso.
2National Institute for the Environment and Agricultural Research (INERA) Burkina Faso.
3Biosciences Laboratory, Department of Biology and Physiology Vegetal, Université Ouaga I Pr Joseph KI-ZERBO, 03 BP 7021 Ouagadougou 03, Burkina Faso.

*Corresponding author; E-mail: narson10sawadogo@gmail.com, Tel: 00226 76 48 53 19

Received: 06-10-2020  Accepted: 23-04-2021  Published: 30-04-2021

ABSTRACT

Peanut (*Arachis hypogaea* L.) is a worldwide popular oilseed. In Burkina Faso, production fluctuates from year to year. This fluctuation in yield is linked to the biotic factors which constitute the major constraints of peanuts. To this end, many breeding programs have been set up to select disease-resistant varieties to improve yields. It is with this in mind that this work focused a genetic analysis of traits related to leaf spot resistance of groundnuts. This study was to evaluate the performance of groundnut genotypes of Indian origin, through field screening to identify leaf spot resistant genotypes with good performance. The experimental device was in a completely randomized Fisher block with three repetitions. After setting up the trial, severity of the disease, percentage of defoliation and yield components were noted. Data from all observations were analyzed using the XLSTAT Pro.1 static analysis software. Statistical analysis of the obtained results showed a significant difference between the obtained values in the different genotypes evaluated for all of the above parameters except the yield. At the end of this study, nineteen (19) resistant genotypes and twenty-three (23) genotypes moderately resistant to leaf spot were identified. These resistant genotypes constitute an additional list of resistant varieties and can be used as a source of resistance in a varietal improvement program.

Keywords: Performance, *Arachis hypogaea* L., ICRISAT collection, India.

INTRODUCTION

Peanut (*Arachis hypogaea* L.) is a worldwide popular oilseed. It is almost grown in all the regions in Burkina Faso. It is mainly processed into oil, flour and derivatives that are part of family and industrial diet. It is then an important source of income for farmers. Groundnut also contributes to the field of agriculture in maintaining agricultural production in Saharan countries where it is grown in rotation with cereals (Faye, 2010). Peanut cultivation is practiced all over the world, with a total area of 26.89 million hectares, world production was 46.04 million hulls in 2020 (USDA, 2021). The largest non-shelled groundnut producing countries are China (17.52 million tons), India (6.26 million tons), Nigeria (3.50 million tons), the United States of America. America (2, 48 million tons) with respective areas planted in hectares of
4.63 million, 4.83 million, 2.80 million and 0.56 million hectares.

In Burkina Faso, production fluctuates year in year out. It increased from 365,887 hull tons in 2016 to 519,345 hull tons in 2017 and in 2018 it will fall to 334,328 hull tons. It will fall slightly in 2019 to 329,783 tons; then it will rose to 334,328 tons in 2020 (MAAH / DGESS, 2020). This fluctuation of yield is linked to structural, abiotic and biotic factors: the real lack of a crop promotion policy is a serious handicap, the climate disturbances, the irregularity of the rainy events during the cropping season are abiotic factors that limit the production of peanuts. However, biotic factors are the first-order constraints that seriously hamper groundnut production. Among these factors are foliar diseases (rust, rosette and early and late leaf spot diseases). These diseases are a major cause of yield losses in the field. with this situation, various control methods were developed to combat them in order to improve production: agricultural practices, biological control, genetic control and chemical control. Among these methods, chemical control is the most used in our countries with acceptable results. But it causes serious environmental and health problems through its toxicities. I response to this situation, the search for other methods of struggle is necessary, such as the use of local plant extracts for the control of peanut leaf diseases (Koita , 2007). To this end, many breeding programs were set up to select disease-resistant varieties to improve yields. It is with this in mind that our work, whose theme is "Appraisal of the performance of peanut genotypes from the ICRISAT collection in India", focuses a genetic analysis of traits related to leaf spot resistance of groundnuts.

The overall objective of this study is to evaluate the performance of groundnut genotypes of Indian origin, through field screening to identify leaf spot resistant genotypes with good performance.

MATERIALS AND METHODS

Experimental location

The experimentation was carried out on the Gampela agricultural site in Burkina Faso. The Gampela experimental site is located about 25 km in the East of Ouagadougou, not far from national road No. 4. The Gampela experimental field extends over 450 ha between the parallels 12024.613 ' and 12025.413' of north latitude and the meridians1020.464 and 1021.652 'of west longitude. It is located in the village of Gampela, administratively attached to the department of Saaba (Kagambega, 2006). The climate of the region is of Sudano-Saharan type. It is characterized by a rainy season from June to October with the maximum rain in August. The soils of the site are very diverse. Ferruginous, hydromorphic soils, lithosols, poorly developed soils with anthropogenic contribution and brown eutrophic soils are noted in order of importance. The pH of the soils varies from 5 to 6.3; and presents constraints which are inter alia the low organic matter content, the low retention capacity (Sankara, 1997).

Plant material

The plant material used for this study consists of seventy-six (76) groundnut genotypes including seventy-four (74) genotypes from the ICRISAT India collection and two controls, the TS32-1 genotype was used as a control susceptible to leaf spot disease originating from Burkina Faso and the PC 79-79 genotype as a resistant control originating from Senegal. The characteristics of the different genotypes used are contained in (Table 1).

Experimental design

The experiment was carried out in Gampela according to Fisher's experimental block device completely randomized with three repetitions. Each repetition was subdivided into two sub-blocks. The sub-blocks of the same repetition are spaced 0.5 m apart. The distance between repetitions was 1 m. Each genotype was sown on an elementary plot of 2 lines of 3m each by repetition at the rate of one seed per pouch. The distance between the lines was 0.50 m and that between the pockets was 0.15 m. To protect the test, we sowed three lines of the Nama variety (resistant variety) as border lines all around the test. The trial was
oriented from north to south and the first parcel started from the west by the IP196 variety.

**Evaluation of the severity of leaf spot diseases**

Late leaf spot disease severity scoring was done at 30 and 105 days after sowing (DAS) (at harvesting maturity) using a modified nine-point scale (Subrahmanyam et al., 1995) (Table 2 and Figure 2), where a score of 1 was rated as highly resistant (HR), 2 to 4 as resistant (R), 5 and 6 as moderately resistant (MR), 7 and 8 as susceptible, and 9 as highly susceptible (HS).

**Evaluation of the percentage of defoliation**

Defoliation is assessed at harvest, so at the stage of maximum loss of leaves. It reflects the degree of incidence of the disease on peanut plants expressed by leaf fall. Thus, on each plot, the measurement is made on the main stems of five plants selected at random. The number of fallen leaves is obtained by counting the leaf locations on the main stem. The percentage is obtained by relating the number of fallen leaves to the number of total leaves (present and absent) reduced to one hundred.

\[
\text{% DE} = \left( \frac{\text{Nbr of L fallen}}{\text{Total Nbr of leaves}} \right) \times 100
\]

**Measure of performance components**

Pods, which are the essential components of yield, are sun-dried in sacks after harvest by variety and repetition. The pods of each genotype are then weighed and the pod yields in tons / ha are determined.

**Statistical analysis**

Data from all observations were analyzed using the XLSTAT Pro 7.1 statistical analysis software. A variance analysis followed by an average comparison using the Duncan test at the 5% threshold, made it possible to determine the genotypes that best resist to Sigatoka diseases. Histograms, curves and tables were constructed using the Microsoft Excel 2013 software.

**Table 1: Characteristics of peanut varieties used in experimentation.**

| CODE | GENOTYPES | IDENTITY | ORIGIN |
|------|-----------|----------|--------|
| IP2  | ICG-76    | T27      | India  |
| IP4  | ICG-111   | C50      | Unknown|
| IP7  | ICG-156   | Mungphalli13 | India |
| IP8  | ICG-163   | S 42     | Unknown|
| IP18 | ICG-532   | AH 6857  | Unknown|
| IP19 | ICG-721   | 6842     | USA    |
| IP20 | ICG-862   | C 121    | India  |
| IP22 | ICG-928   | EC 16690 (PC) | Unknown|
| IP26 | ICG-1399  | U 2-4-1; EC 21151 | Malawi |
| IP27 | ICG-1415  | U 2-24-5; EC 21161; JE 59 | Senegal |
| IP29 | ICG-1668  | NCAC 2730 | USA    |
| IP35 | ICG-2511  | C21      | India  |
| IP37 | ICG-2772  | Kano 50  | Nigeria |
| IP38 | ICG-2773  | Kanyoma  | Tanzania|
| IP39 | ICG-2777  | Limdi 219-3 | India  |
| IP40 | ICG-2857  | US 57    | Argentina|
| IP41 | ICG-2925  | C 145-12-P-16 | India  |
Table 1: Characteristics of peanut varieties used in experimentation (next steps).

| CODE | Genotypes   | Identity                  | Origin        |
|------|-------------|---------------------------|---------------|
| IP42 | ICG-3027    | HG3                       | India         |
| IP43 | ICG-3053    | 275                       | India         |
| IP57 | ICG-3992    | Local 3                   | India         |
| IP58 | ICG-4156    | AH7002                    | Unknown       |
| IP59 | ICG-4343    | NG268                     | India         |
| IP60 | ICG-4389    | IC22951                   | India         |

| CODE | Genotypes   | Identity                  | Origin       |
|------|-------------|---------------------------|--------------|
| IP61 | ICG-4412    | USA60                     | USA          |
| IP62 | ICG-4527    | Teso                      | Uganda       |
| IP63 | ICG-4538    | 27-janv                   | India        |
| IP66 | ICG-4598    | Hyderabad                 | India        |
| IP70 | ICG-4746    | P1 298115; line 136       | Israel       |
| IP74 | ICG-4955    | AH7065; HG6               | India        |
|      |             | P1269060; NCAC9977; IN5940K |              |
| IP75 | ICG-4998    | 487                       | China        |
| IP78 | ICG-5195    | U 4-7-15; EC 21097        | Sudan        |
| IP82 | ICG-5327    | EC 112032; MC Fla 14      | USA          |
| IP83 | ICG-5475    | AH 6666                   | Kenya        |
| IP84 | ICG-5494    | AH 7234                   | Malaysia     |
| IP87 | ICG-5609    | AH 7144; Small Spanish    | Sri Lanka    |
| IP89 | ICG-5663    | AH 7325                   | China        |
| IP92 | ICG-5827    | UF 439-16-6; NCAC 17348   | USA          |
| IP94 | ICG-5891    | VRR 125 P1 162859; NCAC 927; Baladibunch | India |
| IP96 | ICG-6057    | NCAC 17773                | USA          |
| IP107| ICG-6813    | 11                        | Senegal      |
| IP109| ICG-6892    | NCAC 17591                | USA          |
| IP113| ICG-7153    | VRR 299                   | India        |
| IP124| ICG-8490    | RG 159; Somaliaali        | Somalia      |
| IP128| ICG-9037    | 57-295                    | Ivory Coast  |
| IP135| ICG-9666    | VRR 663                   | India        |
| IP136| ICG-9777    | RPM 13; Mative            | Mozambique   |
| IP137| ICG-9809    | RPM 145; Mative           | Mozambique   |

698
### Table 1: Characteristics of peanut varieties used in experimentation (end).

| CODE  | Genotypes    | Identity          | Origin            |
|-------|--------------|-------------------|-------------------|
| IP145 | ICG-10185    | 52-32             | USA               |
| IP148 | ICG-10479    | P1 259694; Mani aceiters | Uruguay         |
| IP153 | ICG-1109     | P1 230192; EG     | Taiwan            |
| IP158 | ICG-11426    | CS 2414           | India             |
| IP159 | ICG-11457    | AMR 151           | India             |
| IP164 | ICG-11855    | Suweon 45; 300521 | République de Coree |
| IP167 | ICG-12000    | RS 128-2 red; Zorowoule | Mali            |
| IP169 | ICG-12276    | BPZ 71 overo      | Bolivia           |
| IP170 | ICG-12370    | AKG 280 BPZ 691 purple; P1497597; Rojo del | India |
| IP171 | ICG-12625    | Oriente           | Ecuador           |
| IP172 | ICG-12672    | US 824; US 824-2; P1 497404; Overo | Bolivia |
| IP176 | ICG-12921    | AMM 1452 Tan      | Zimbabwe          |
| IP177 | ICG-12988    | US 22             | India             |
| IP178 | ICG-13099    | U 118             | Unknown           |
| IP180 | ICG-13525    | GNAK 377          | Republic of Central-African |
| IP184 | ICG-13723    | 37 GG2            | Niger             |
| IP185 | ICG-13787    | 91 GG2            | Niger             |
| IP189 | ICG-13942    | ICGS 76           | Costa RicaSAT     |
| IP191 | ICG-14008    | AK 471            | Central African Republic |
| IP196 | ICG-14466    | AON 778           | Nigeria           |
| IP197 | ICG-14475    | AON827            | Nigeria           |
| IP198 | ICG-14482    | AON 857           | Nigeria           |
Table 2: Modified 9-point scale used for field screening groundnut genotypes for resistance to late leaf spot.

| Disease Score | Description                                                |
|---------------|------------------------------------------------------------|
| 1             | No disease                                                 |
| 2             | Some lesions on old leaves; no defoliation                 |
| 3             | Some small spots mainly on old leaves, very few on middle leaves; defoliation |
| Points | Description |
|--------|-------------|
| 4      | Spots on lower and middle leaves but severe on lower leaves; obvious defoliation of some leaflets on lower leaves |
| 5      | Visible spots on lower and middle leaves; yellow and moderate sporulation, fall of some basal leaves. |
| 6      | Severe lesions on lower and middle leaves; lesions present but less severe on top leaves; extensive defoliation of lower leaves; defoliation of some leaflets evident on middle leaves |
| 7      | Lesions on all leaves but less severe on top leaves; defoliation of all lower and some middle leaves |
| 8      | Defoliation of all lower and middle leaves; severe lesions on top leaves; some defoliation of top leaves evident |
| 9      | Almost all leaves defoliated, leaving bare stems; some leaflets may remain, but show severe leaf spots |

Subrahmanyam et al., 1995

Figure 2: Modified 9-point disease scale for field evaluation of late leaf spot (Rao et al., 1990).
RESULTS

Evaluation of the severity of leaf spot diseases and the percentage of defoliation

Table 3 shows the results of the analysis of variance of the last leaf spot scores and the average percentages of defoliation at the time of harvest. Variance analysis for the severity of leaf spot showed a very highly significant difference between the different genotypes at the 5% threshold (P < 0.0001). Leaf spot disease severity scores range from 2 to 7.5. The genotypes IP137, IP87, IP84, IP83, IP78, IP180, IP176, IP184, IP27, IP177, IP26, IP74, IP178 and the sensitive control TS32-1 recorded the highest leaf spot scores between 6 and 7.5. They are statistically superior to other genotypes. The PC79 genotype scored 3.5; it is statistically equivalent to thirteen (13) other genotypes. For the percentage defoliation character whose average is 53.77%. The genotype with the highest score is IP83 with 96, 93%, and is statistically equivalent to 13 genotypes including the susceptible genotype with defoliation percentages between 77.46 and 94.46%. The lowest rates were recorded by the IP158, IP19, IP20, IP167, IP35, IP135, IP61, IP148, IP136, IP40, IP94 genotypes and the PC79-79 control.

The yield is in t / ha

The analysis of variance in mean yields revealed a non-significant difference between genotypes. The pod yield averages 1.50 t / ha in the site. The IP63 genotype had the highest yield (2.70 t / ha). All genotypes are statistically equivalent with the letter “a” and yield between 0.64 and 2.70 tons. The lowest yield was recorded by the IP148 genotype (0.64 t / ha). The resistance control, PC 79-79 gave a yield of 1.44 t / ha and the sensitive control TS32-1 1.93 t / ha.

Table 3: Average values for leaf spot, percent defoliation and yield.

| Genotypes | Leaf spot | Genotypes | DF | Genotypes | Yield (t/ha) |
|-----------|-----------|-----------|----|-----------|--------------|
| IP137     | 7,50 a    | IP83      | 96,93 a | IP63      | 2,70 a       |
| TS32-1    | 7,50 a    | IP84      | 94,46 ab | IP83      | 2,27 ab      |
| IP87      | 7,33 ab   | IP137     | 94,33 ab | IP42      | 2,20 ab      |
| IP84      | 7,33 ab   | TS32-1    | 92,76 ab | IP172     | 2,16 ab      |
| IP83      | 7,33 ab   | IP176     | 91,40 ab | IP59      | 2,14 ab      |
| IP78      | 7,16 a-c  | IP180     | 90,93 ab | IP82      | 2,14 ab      |
| IP180     | 7,16 a-c  | IP87      | 90,10 ab | IP198     | 2,14 ab      |
| IP176     | 7,16 a-c  | IP78      | 89,96 ab | IP201     | 2,06 ab      |
| IP196     | 6,83 a-d  | IP184     | 82,90 a-c | IP66    | 2,00 ab      |
| IP184     | 6,66 a-e  | IP178     | 80,36 a-d | IP29      | 1,99 ab      |
| IP169     | 6,66 a-e  | IP177     | 79,80 a-d | TS32-1  | 1,93 ab      |
| IP27      | 6,50 b-e  | IP26      | 78,90 a-e | IP199     | 1,91 ab      |
| IP177     | 6,50 b-e  | IP196     | 78,70 a-e | IP57      | 1,91 ab      |
| IP26      | 6,33 c-f  | IP169     | 77,46 a-f | IP178     | 1,83 ab      |
| IP74      | 6,16 d-g  | IP74      | 76,40 b-g | IP96      | 1,81 ab      |
| IP178     | 6,00 d-h  | IP27      | 76,03 b-h | IP40      | 1,81 ab      |
| IP82      | 5,83 e-i  | IP189     | 69,26 c-i | IP19      | 1,78 ab      |
| IP171     | 5,83 e-i  | IP109     | 67,66 c-j | IP145     | 1,76 ab      |
| IP189     | 5,50 f-j  | IP82      | 66,73 c-k | IP35      | 1,70 ab      |
| IP172     | 5,50 f-j  | IP172     | 64,10 c-l | IP4       | 1,68 ab      |
| IP58      | 5,33 g-k  | IP171     | 62,06 d-m | IP167     | 1,68 ab      |
| IP89      | 5,33 g-k  | IP66      | 59,03 e-n | IP124     | 1,65 ab      |
| IP62      | 5,33 g-k  | IP113     | 58,50 f-n | IP170     | 1,64 ab      |
| IP109     | 5,33 g-k  | IP145     | 58,03 f-n | IP177     | 1,64 ab      |
| IP | Value   | Description | IP | Value   | Description | IP | Value   | Description |
|----|---------|-------------|----|---------|-------------|----|---------|-------------|
| IP43 | 5.16 h-l | IP191 | 57.93 f-n | IP171 | 1.63 ab |
| IP201 | 5.16 h-l | IP159 | 57.76 f-n | IP94 | 1.62 ab |
| IP113 | 5.16 h-l | IP92 | 57.20 g-n | IP62 | 1.62 ab |
| IP145 | 5.00 i-m | IP60 | 56.83 g-n | IP18 | 1.59 ab |
| IP128 | 5.00 i-m | IP62 | 56.66 g-n | IP180 | 1.58 ab |
| IP92 | 5.00 i-m | IP58 | 56.13 g-o | IP184 | 1.57 ab |
| IP75 | 5.00 i-m | IP89 | 55.76 h-o | IP61 | 1.57 ab |
| IP191 | 5.00 i-m | IP37 | 55.56 i-o | IP139 | 1.56 ab |
| IP41 | 5.00 i-m | IP8 | 55.33 i-p | IP189 | 1.56 ab |
| IP66 | 5.00 i-m | IP141 | 55.16 i-p | IP7 | 1.54 ab |
| IP8 | 4.83 j-n | IP41 | 54.96 i-p | IP136 | 1.53 ab |
| IP39 | 4.83 j-n | IP199 | 54.80 i-p | IP89 | 1.51 ab |
| IP38 | 4.83 j-n | IP7 | 54.76 i-p | IP27 | 1.49 ab |
| IP70 | 4.83 j-n | IP59 | 54.73 i-p | IP87 | 1.48 ab |
| IP63 | 4.83 j-n | IP197 | 54.66 i-p | IP159 | 1.47 ab |
| IP7 | 4.83 j-n | IP63 | 54.53 i-p | IP113 | 1.47 ab |
| IP59 | 4.66 j-o | IP75 | 54.33 i-p | IP60 | 1.45 ab |
| IP159 | 4.66 j-o | IP124 | 53.83 i-p | PC79-79 | 1.44 ab |
| IP18 | 4.66 j-o | IP57 | 52.36 i-q | IP141 | 1.44 ab |
| IP37 | 4.66 j-o | IP201 | 52.16 i-q | IP37 | 1.43 ab |
| IP124 | 4.66 j-o | IP128 | 51.20 i-q | IP164 | 1.43 ab |
| IP141 | 4.66 j-o | IP153 | 50.70 i-r | IP191 | 1.43 ab |
| IP60 | 4.66 j-o | IP38 | 50.46 i-r | IP197 | 1.42 ab |
| IP170 | 4.50 k-p | IP170 | 50.13 i-r | IP169 | 1.40 ab |
| IP199 | 4.50 k-p | IP43 | 48.63 i-r | IP58 | 1.40 ab |
| IP42 | 4.50 k-p | IP18 | 48.03 j-r | IP89 | 1.51 ab |
| IP57 | 4.33 l-q | IP107 | 46.80 j-r | IP27 | 1.49 ab |
| IP198 | 4.33 l-q | IP22 | 45.73 k-s | IP87 | 1.48 ab |
| IP197 | 4.33 l-q | IP70 | 45.23 l-s | IP159 | 1.47 ab |
| IP107 | 4.33 l-q | IP185 | 45.10 l-s | IP113 | 1.47 ab |
| IP153 | 4.16 m-r | IP42 | 44.36 l-s | IP60 | 1.45 ab |
| IP29 | 4.00 n-s | IP39 | 43.20 l-t | PC79-79 | 1.44 ab |
| IP164 | 4.00 n-s | IP198 | 42.60 m-u | IP141 | 1.44 ab |
| IP139 | 3.83 o-t | IP164 | 41.06 m-u | IP37 | 1.43 ab |
| IP185 | 3.83 o-t | IP138 | 40.76 n-u | IP8 | 1.33 ab |
| IP96 | 3.66 p-u | IP2 | 35.66 o-v | IP138 | 1.32 ab |
| PC79-79 | 3.50 q-u | IP139 | 34.60 o-v | IP78 | 1.28 ab |
| IP138 | 3.33 r-u | IP96 | 32.03 q-w | IP84 | 1.24 ab |
| IP19 | 3.33 r-u | IP29 | 30.43 r-w | IP74 | 1.21 ab |
| IP2 | 3.33 r-u | IP4 | 26.16 s-w | IP158 | 1.19 ab |
| IP167 | 3.16 s-u | PC79-79 | 25.63 s-w | IP176 | 1.17 ab |
| IP20 | 3.00 t-u | IP94 | 24.20 t-w | IP2 | 1.10 ab |
| IP4 | 3.00 t-u | IP40 | 23.90 t-w | IP153 | 0.91 ab |
| IP136 | 3.00 t-u | IP136 | 23.16 t-w | IP70 | 0.90 ab |
| IP135 | 3.00 t-u | IP148 | 22.93 u-w | IP41 | 0.89 ab |
| IP94 | 3.00 t-u | IP61 | 20.50 v-w | IP185 | 0.87 ab |
| IP61 | 3.00 t-u | IP135 | 20.26 v-w | IP20 | 0.84 ab |
| IP40 | 3.00 t-u | IP35 | 19.50 v-w | IP92 | 0.81 ab |
| IP35 | 3.00 t-u | IP167 | 19.46 v-w | IP26 | 0.80 ab |
| IP22 | 3.00 t-u | IP20 | 19.40 v-w | IP128 | 0.78 ab |
**DISCUSSION**

The average leaf spot rating was 4.85. This average is relatively low this is in line with the results of (Neya, 2007) who found that the Gampela site in the central region has low ratings. This low average will be explained by the fact that the rainfall was low with an average of 665.1 mm from our semi date. In fact, environmental conditions required for both types of leaf spot are the long periods of high humidity or leaf wetness Tshilenge Lukanda et al. (2012). The notation has shown that the genotypes TS32-1, IP137, IP87, IP84, IP83, IP78, IP180, IP176 are sensitive and the other genotypes resist (medium or strong) to leaf spot. The resistance of these could be explained by the presence of an additive gene that would control this resistance. In additionally, Khedikar et al. (2010) reported that the genetic determinism of this resistance is polygenic and is probably controlled by several recessive genes. The observation of the results of the defoliation indicates that it was very strong this year on the site of Gampela. Defoliation is a natural phenomenon related to leaf senescence and is aggravated by factors such as leaf spot attack and drought. In our case, it is very likely that it is drought. Indeed, the rainfall for this year 2016 was characterized by a dry pocket throughout the month of October. The amount of rain recorded during this month was 3mm. These repeated droughts could explain the strongest defoliation recorded in this site. Our results are similar to those of Neya et al. (2013) who worked under the same Gampela conditions and noted that defoliation accelerates at the end of vegetation (mid-October) when there is a relative drought situation. This does not exclude the fact that it may be related to the severity of leaf spot.

Indeed, Hamasselbe et al. (2011); Gaikpa et al. (2015), believe that there is a strong positive (or negative) correlation between the severity of leaf spot attack and defoliation. Finally, genotypes did not all have the same percentage of defoliation. This could be explained by their intrinsic capacity to control leaf abscission (Neya, 2007). For yield, the average genotype was 1.5 t / ha which is generally satisfactory. These results are in agreement with those of (Sirima ,2013) who worked on genotypes of American origin. This situation is largely linked to the nature of the soil. Indeed, SANKARA in 1997 showed that Gampela soils are suitable for groundnut cultivation because of their richness in mineral elements. The best yields were obtained by genotypes that showed a moderate level of resistance to leaf spot but also by some sensitive genotypes. This high yield of susceptible genotypes is explained by their intrinsic ability to tolerate the disease. It is possible that these genotypes can complete their cycles before the intervention of the disease. In addition, Mendez et al. (2016) noted that early genotypes are able to dodge the disease while late genotypes are unable to dodge because of the length of their cycles. This does not rule out the decrease in yield related to the sensitivity of the disease. Indeed, Thakur et al. (2012) reported that leaf spot is the main peanut disease that causes 50% yield loss and more.

**Conclusion**

The appraisal of the performances of Indian genotypes went through an estimation of several parameters which allowed us to enrich our knowledge on these different...
genotypes. At the end of this study, we take into account the different results obtained, that the site of Gampela is conducive to the cultivation of peanuts. The appraisal of these genotypes shows through the analysis of their performances that they have a moderate resistance to the disease. We could say that the genotypes IP158, IP148, IP22, IP35, IP40, IP61, IP94, IP135, IP136, IP4, IP20, IP167, IP2, IP19, IP138, IP61, IP96, IP185, IP139 have good resistance to disease. Among these genotypes are the IP35 genotypes, IP40, IP94, IP19, IP96 and moderately resistant genotypes IP63, IP42, IP172, IP59, IP198, IP201, IP66 which have obtained satisfactory yields. They can be qualified as promising genotypes for future extension in peasant environments.

COMPETING INTERESTS
The authors declare that they have no competing interests.

AUTHORS’ CONTRIBUTIONS
RBS managed the literature research, designed the study, wrote the protocol, participated in data collection and performed the statistical analysis, and wrote article. KMLG managed the analyses of study, and wrote article. MBZ participated in data collection, data analysis and wrote the first draft of the manuscript. SN corrected the manuscript. PS was the principal investigator.

ACKNOWLEDGMENTS
Our thanks go to the farmers and Almissi SAWADOGO for facilitating the implementation of the study and collection of data.

REFERENCES
DGESS. 2020. Rapport des résultats définitifs de la campagne agropastorale et perspectives alimentaire et nutritionnelle. Ministère de l’agriculture de l’hydraulique et des ressources halieutiques, Ouagadougou, Burkina Faso.

Faye I. 2010. Contrôle génétique de la dormance des graines fraîches chez des variétés d’arachides (Arachis hypogaea L.) de type spanish et recherche de marqueur microsatellites liés au caractère. Thèse de docteur de troisième cycle Université Cheikh Anta Diop de Dakar. 132p.

Gaikpa DS, Akromah R, Asibuo JY, Appiah-kubi Z, Nyadanu D. 2015. Evaluation of yield and yield components of groundnut genotypes under Cercospora leaf spots disease pressure. Int. J. Agron. Agric. Res., 7: 66-75. DOI : 10.5958/0975-928X.2019.00105.4

Hamasselbe A, Sadou I, Klassou C. 2011. Genetic variability and correlation among traits explaining resistance to cercospora leaf spots in groundnut (Arachis hypogaea L.). Int. J. Biol. Chem. Sci., 5(3): 1135-1142. DOI : 10.4314/ijbcs.v5i3.72241

Kagambega W.F. 2006. Etudes floristique et phytosociologique de la station expérimentale de Gampela (zone nord soudanienne du Burkina Faso). Mémoire de DEA. Université de Ouagadougou, p.61.

Khedikar Y P, Gowda MV, Sarvamangala C, Patgar KV, Upadhyaya H D, Varshney R K. 2010. A QTL study on late leaf spot and rust revealed one major QTL for molecular breeding for rust resistance in groundnut (Arachis hypogaea L.). Theoretical and Applied Genetics, 121 : 971–984. DOI: 10.1007/s00122-010-1366-x

Koita K. 2007. Etude de l’efficacité d’extraits végétaux sur les maladies foliaires de l’arachide (Arachis hypogaea L.). Mémoire de fin d’étude pour l’obtention du diplôme d’Études Approfondies (DEA) en sciences biologiques appliquées, UFR/SVT, université de Ouagadougou, p.67.

Mendez N, Joseba AL, Luis A B, Cedeno. 2016. Screening of Indian peanut genotypes for resistance to cercospora leaf-spot under savanna conditions. Emirates journal of food and Agriculture, 28(12): 833-841. DOI: 10.9755/efja.2016-02-146http://www.ejfa.me/
Neya BF. 2007. Criblage de quelques génotypes d’arachide (*Arachis hypogaea* L.) croisés et sélectionnés aux États-Unis pour la résistance aux maladies foliaires : rouille, cercosporiose, rosette. Mémoire de DEA, UFR/SVT, Université de Ouagadougou, p.37.

Neya FB, Koita K, Zagre MB, Nana AT, Burow MD, Sankara P, Simpson C. 2013. Evaluation au champ de la performance de quelques lignées d’arachide (*arachis hypogaea* L.) à grosses graines pour la résistance aux cercosporiose de l’arachide. *Annale de l’Université de Ouagadougou*, 9.

Rao PV, Subrahmanyan P, Reddy M. 1990. A Modified 9-Point Disease Scale for Assessment of Rust and Late Leaf Spot of Groundnut. Proc. Second International Congress of French Phytopathological Society, Montpellier, France, p.25.

Sankara P. 1997. Évaluation des performances agronomiques et de la résistance à la rouille de génotypes d’arachide pour la création d’un idéotype au Burkina Faso. Thèse d’Etat, FAST, Université de Ouagadougou, p.219.

Sirima A. 2013. Évaluation de génotypes d’arachide (*Arachis hypogaea* L.) d’origine américaine pour la résistance à la cercosporiose dans deux localités du Burkina Faso : Gampêla et Farako-bâ. Mémoire de fin d’étude, Université de Ouagadougou, p.77.

Subrahmanyam P, Donald D, Waliyar F, Reddy LJ, Nigam SN, Gibbons RW, Rao VR, Singh AK, Pande S, Reddy PM, Subba Rao PV. 1995. Screening methods and sources of resistance to rust and late leaf spot of groundnut. *Information Bulletin*, p.24.

Thakur SB. 2014. Variability on Component Traits of Pod Yield, Drought Tolerance and Leaf Spot Disease Resistance of Groundnut (*Arachis hypogaea*. L.). Ph.D. Dissertation, Tribhuvan University, Rampur, Chitwan, Nepal, p.148.

Tshilenge-Lukanda KKC, Nkongolo A, Kalonji-Mbuyi RV, Kizungu. 2012. Epidemiology of the Groundnut (*Arachis hypogaea* L.) Leaf Spot Disease : Genetic Analysis and Developmental Cycles *American Journal of Plant Sciences*, 3 : 582-588. DOI : http://dx.doi.org/10.4236/ajps.2012.35070

USDA. 2021. World agriculture production. Room 326-W, Whitten Building, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410 or call (202) 720-5964.