INTERNATIONAL PEARL MILLET DISEASE RESISTANCE TESTING PROGRAM

(IPMDRTP)

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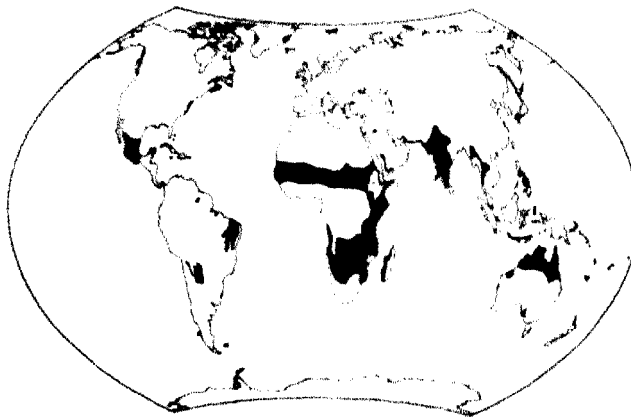

REPORT ON

THE 1980 INTERNATIONAL PEARL MILLET SMUT NURSERY

(IPMSN)

ICRISAT

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ABSTRACT

The 32 entry 1980 International Pearl Millet Smut Nursery (IPMSN) was tested at 5 West African and 5 Indian locations. Two entries (SSC FS 252-S-4 and EBS 137-2-S-1-DM-1) were highly resistant (mean smut severities between 0 and 4%) across locations and 22 of the 32 entries had across location mean smut severities of less than 10%. Among the test locations Kano and Samaru provided the greatest smut pressures with indications of possible existence of pathogenic variability.

RESUME

Les 32 entrées de la Pépinière internationale de 1980 pour le charbon du mil à chandelle (IPMSN) ont été testées sur 5 emplacements en Afrique occidentale et 5 emplacements en Inde. Deux entrées (SSC FS 252-S-4 et EBS 137-2-S-1-DM-1) se sont montrées très résistantes (la sévérité moyenne de charbon se situant entre 0 et 4%) sur l'ensemble des emplacements. D'autre part, pour 22 des 32 entrées, la sévérité de charbon s'est révélée inférieure à 10% sur l'ensemble des emplacements. Parmi les différents emplacements expérimentaux, ce sont ceux de Kano et Samaru où s'est manifestée la plus grande sévérité de charbon et où sont apparus des signes indicateurs d'une possibilité de variabilité pathogène.

REPORT ON THE 1980 INTERNATIONAL PEARL MILLET SMUT NURSERY

INTRODUCTION

The International Pearl Millet Smut Nursery (IPMSN) is one of the component nurseries in the International Pearl Millet Disease Resistance Testing Program (IPMDRTP) coordinated by the ICRISAT Pearl Millet Improvement Program. Through the assistance of cooperators in diverse locations throughout the semi-arid tropics the IPMDRTP aims to identify sources of disease resistance that is stable across pathogen populations and environments. The IPMSN was initiated in 1977 with the participation of cooperators in Senegal, Nigeria, and India and five promising lines were identified. In 1978 the IPMSN was sent to cooperators at 12 locations in 7 countries and the results were received from 6 locations in 4 countries. Ten of the 34 entries were identified promising with across locations mean smut severity of not more than 10 percent. In 1979 the 37 entry IPMSN was sent to cooperators at 6 locations in 5 countries and the results were received from 4 locations in 3 countries. Five entries were identified as highly resistant with across locations mean smut severity of less than 1 percent. The 1980 IPMSN was sent to cooperators at 8 locations in 4 countries and results received from 6 locations in 3 countries are presented in this report.

LOCATIONS AND COOPERATORS

The 1980 IPMSN sets were distributed to six cooperators at eight locations. Data were received from cooperators at three West African and three Indian locations (Table 1).

ENTRIES

The 35 entries included the 12 best entries from the 1979 IPMSN, 20 new entries selected in the ICRISAT smut screening nursery at Hissar during the 1979 rainy season, and 3 checks (local resistant, local susceptible, and a trial check).

NURSERY MANAGEMENT AND INOCULATION

Cooperators were requested to plant the nursery in two replications of 2 x 4m rows (two 4m rows per entry per replication) and follow the normal cultural and fertilization practices recommended at the location. The cooperators were advised to inject-inoculate 10 plants per row per replication at the boot leaf stage with an aqueous sporidial suspension obtained either from culture (on potato-agar/carrot-agar) or from the 24 hr water-suspended spore balls, and to bag the heads with paper bags immediately after inoculation. At locations where inoculation could not be done bagging the heads at the boot leaf stage was suggested.

At all the locations except Bambey (Senegal) inoculations were made using smut sporidial suspension.

SMUT SCORING

Cooperators were provided with a set of standard drawing of variously smutted pearl millet inflorescences to facilitate estimation of percent smut infection severity. Scorings were done at crop maturity on the 20 inoculated and/or bagged inflorescences per entry per replication. The mean smut severities of 40 inflorescences/entry are used in this report.

DATA REQUESTED

In addition to the smut data, cooperators were requested to record weather data (rainfall and temperature), days to 75 percent flowering, and score the entries for other prevalent diseases such as ergot, downy mildew, rust, and blast.

RESULTS

Weather

Data on number of rainy days, amount of rainfall, and temperature (max. and min.) during the inoculation and/or bagging to observation period for each location are presented in Table 2. The maximum rainy days (24) and rainfall (417 mm) occurred at Kano followed by Samaru (22 rainy days and 258.4 mm rainfall) and ICRISAT Center (20 rainy days and 386 mm rainfall). There was no rain at Hissar. Bambey and Hissar had the highest maximum temperatures (38.4 C and 37.2 C, respectively) while Jamnagar and Samaru had the lowest minimum temperature (20.6 C).

The planting dates varied from 16 June (Samaru) to 8 August (Bambey) and similarly the periods from inoculation to observation varied from 18 July-15 September (Samaru) to 15 September-15 October (Bambey).

Performance of test entries

For each entry, the mean and range of smut severity, scores for other diseases, and days to 75% flowering are presented, by locations in Tables 3 to 8. The individual entry means, entry means across locations, and location means across the test entries are presented in Table 9.

Since there was considerable variability among plants within entries the range, mean, and maximum severities are all significant. However, in order to evaluate the reactions of the test entry at any one location, the mean smut severity compared with the mean smut severity on BJ-104 is a most useful indicator.

The greatest smut pressure occurred at Kano (location mean 18%) and the least pressure occurred at Hissar, ICRISAT Center, and Jamnagar (location means 3%) (Table 9). Kano and Samaru provided higher smut pressure (72% and 68% severity, respectively on BJ 104) than the three Indian locations, and Bambey (where artificial inoculation was not done. Because of dry weather at Hissar and Jamnagar during flowering, heavy smut did not develop despite inoculation. At ICRISAT Center this year, inoculation was successful and relatively high smut pressure

(61% severity on BJ 104) occurred, due probably to the frequent sprinkler irrigations during the inoculation-observation period.

At Hissar (Table 3), 2 entries were smut-free, 16 entries had mean smut severities of not more than 1%, and the remaining 14 entries had mean smut severities between 3 and 23%.

The local resistant, the local susceptible, and the trial check (BJ 104) had smut severities of 5, 26 and 30% respectively.

At Jamnagar (Table 4), 6 entries were smut-free, 15 entries had mean smut severities of not more than 1%, and the remaining 11 entries had mean severities between 2 and 15%. The local resistant, the local susceptible, and the trial check (BJ 104) had mean smut severities of 28, 24 and 31% respectively.

At ICRISAT Center (Table 5), 3 entries were smut-free, 17 entries had mean smut severities of not more than 1%, and the remaining 12 entries had mean smut severities between 2 and 38%. The local resistant, the local susceptible, and the trial check (BJ 104) had mean smut severities of 1, 57 and 61% respectively.

At Bambey (Table 6), 1 entry was smut-free, 15 entries had mean smut severities of not more than 1%, and the remaining 16 entries had mean smut severities between 2 and 40%. The local resistant, the local susceptible, and the trial check (BJ 104) had mean smut severities of 9, 13 and 31% respectively.

At Samaru (Table 7), no entry was smut-free, although 9 entries had mean smut severities between 1 and 10%. The remaining 23 entries had mean smut severities in the range of 11 to 41%. The local resistant, the local susceptible, and the trial check (BJ 104) had mean smut severities of 28, 41 and 68% respectively.

At Kano (Table 8), no entry was smut-free, 13 entries had mean smut severities between 1 and 9% and the remaining 19 entries had smut in the range of 11 to 49%. The local resistant, the local susceptible and the trial check BJ 104 had mean smut severities of 16, 15 and 72% respectively.

Although no entry was smut-free at all locations, 2 entries had mean smut severity of 1% and 20 entries had across locations mean smut severities between 3 and 9% (Table 9). The trial check BJ 104 had the greatest mean smut severities at each location, except at Bambey where 3/4 [x Bornu-220-S-1-DM-1 had more smut (40% mean smut severity compared with 31% mean smut severity in BJ 104).

FLOWERING TIME AND SMUT DEVELOPMENT

Flowering was latest at Hissar (ranging from 43 to 71 days) and earliest at Kano (ranging from 35 to 56 days). The mean DTF of test entries across locations varied between 49 and 64. The trial check BJ 104 flowered earliest at all the locations.

The five earliest flowering entries (49 to 51 days) had mean smut severity between 3 and 12% and the five latest flowering entries (59 to 64 days) had mean smut severities between 1 and 4%. There was no significant correlation between DTF and smut severity.

OTHER DISEASES

Cooperators from four of the six locations provided useful information on other diseases including ergot and downy mildew.

ERGOT

At Jamnagar, the ergot severity ranged from 0 to 10% and the 10 smut high resistant entries had ergot in the range of 1 to 6% (Table 4). At ICRISAT Center, all the IPMSN entries developed heavy ergot under high inoculum pressure with the mean severities ranging from 10 to 75%. The top 10 smut high resistant entries had ergot in the range of 10 to 63% (Table 5). At Samaru all the entries showed high ergot susceptibility with severity ranging between 20 and 90%, and the top 10 smut resistant entries had ergot in the range of 10 to 75% (Table 7). At Kano, the ergot severity ranged between 5 and 55% and the top 10 smut resistant entries had ergot severity in the range of 5 to 55% (Table 8).

Downy Mildew

At Jamnagar where downy mildew incidence ranged from 0 to 17%, 17 of the 32 test entries were downy mildew-free, and the top 10 smut resistant entries had downy mildew incidence in the range of 0 to 3% (Table 4). At ICRISAT Center, the downy mildew incidence ranged from 0 to 36% on the test entries and 12 of the 32 entries were downy mildew-free (Table 5). At Samaru, the downy mildew incidence was quite high ranging from 9 to 91% and the top 10 smut resistant entries had downy mildew incidence between 9 and 57% (Table 7). At Kano, the downy mildew incidence ranged from 11 to 98% and the top 10 smut resistant entries had downy mildew incidence between 25 and 94% (Table 8).

Rust and Blast

These two diseases were recorded at Samaru. All the entries were rust-free and blast incidence ranged from 1 to 3 on a 1-5 scale. Nineteen of the 32 entries were blast-free and only one entry had a score of 3, and the remaining 12 entries scored 2 (Table 7).

DISCUSSION

The 32 entry 1980 IPMSN was tested at six smut high-pressure locations in India and West Africa. This year's screening was done by artificial inoculations at all the locations except at Bambey, and entries with high levels of smut resistance at and across locations have been identified. Kano and Samaru provided very high smut pressures and some entries that were highly smut resistant at the other four locations were not so at Kano and Samaru. Data presented in Table 10 indicate the differential smut pressures at the test locations. Two entries SSC PS 252-S-4 and EBS 137-2-S-1-DM-1 showed high levels of smut resistance at all the six locations, but the other four entries, although resistant at Hissar, ICRISAT Center, Jamnagar, and Bambey, were not resistant at Samaru and Kano. These differential reactions indicate the possible existence of variable pathogen populations, while the reactions of the other two susceptible entries 3/4 EB 220-S-1-DM-1 and BJ 104 (Table 10) indicate a different situation. The smut reactions of 3/4 EB 220-S-1-DM-1 does not clearly indicate any qualitative or quantitative variability, while reactions of BJ 104 clearly indicate the

quantitative variations in the pathogen across locations. In future our efforts will be to look at the pathogenic variability and determine the factors related to stability of resistance.

Among the various weather factors affecting smut development, the number of rainy days during the critical period of inoculation/bagging to observation appears to have greatly influenced the smut development (Table 11).

Comparative performances of six of the IPMSN common entries for 3 years across six locations are presented in Table 12. SSC FS 252-S-4 was outstanding in performing very well at all locations in all years, and ICI 7517-S-1 also performed well except for one bad score in Kano in 1978.

Although smut pressure does not appear very high at all the locations, it is interesting that most of the test entries had less smut than the local susceptible and the trial check BJ 104 at all the locations.

It is encouraging that selection for smut resistance at Hissar is effective at other locations except at Samaru and Kano where very high disease pressure occurs, with the possible existence of different virulence in the pathogen population. It appears that for the resistance to be effective at Kano and Samaru, initial screening and selection for smut resistance at these locations will be more useful.

Utilization of the identified resistance sources is underway in the ICRISAT Center and national breeding programs to develop smut resistant hybrids and varieties.

MULTILOCATIONAL TESTING IN 1981 AND BEYOND

The 1981 IPMSN with about 30 entries will be available to co-operators at the end of May 1981. Entries will include selections from the better 1980 IPMSN and new entries selected in the ICRISAT screening and breeding programs.

Entries are welcome from scientists in the national and regional programs provided they have been resistant to smut at the home location. Because of plant quarantine requirements in India, seed sent from abroad will take about a year before it can be included in the trial.

SEED SUPPLY

Small quantities of seed of entries listed in this report are available to any scientist. Please send seed requests to the Principal Pathologist, Millet Improvement Program at ICRISAT Center (to the address at the cover) indicating that seed request is from the 1980 IPMSN entries.

Table 1. Locations and Cooperators in the 1980 IPMSN from whom results were received by December 31, 1980

Location	Country	Cooperators
Samaru	Nigeria	N.V. Sundaram
Kano	Nigeria	N.V. Sundaram
Bambey	Senegal	S.C. Gupta and J.A. Frowd
Jamnagar	India	N.A. Thakar and H.R. Dave
Hissar	India	R.P. Thakur
ICRISAT Center	India	R.P. Thakur

Table 2. Planting date, rainfall and temperature data from inoculation to observation at 1980 IPMSN locations

Location & latitude (N^{o})		Planting date	Inoculation to observation period	No. of rainy days	Rainfall (mm)	Temperature oC	
						Max.	Min.
Hissar	29^{o} 10'	Jul.10	Aug.27-Sep.25	0	0	37.2	23.6
ICRISAT Center	17^{o} 26'	Jun.26	Aug. 8-Sep.17	20	386.0	29.0	22.0
Jamnagar	22^{o} 28'	Jul. 7	Aug.20-Oct. 6	5	23.6	36.3	20.6
Bambey	14^{o} 32'	Aug. 8	Sep.15-Oct.15	4	27.1	38.4	21.8
Kano	11^{o} 59'	Jun.20	Jul.25-Sep.18	24	417.0	35.8	23.5
Samaru	11^{o} 11'	Jun.16	Jul.18-Sep.15	22	258.4	31.0	20.6

Table 3. Smut reactions and days to 75 percent flowering (DTF) of the 1980 IPMSN entries during the 1980 rainy season at Hissar

Entry	DTF	Smut Severity(%)			
		Rep 1	Rep 2	Mean[a/]	Range
ICI-7517-S-1	64	0	0	0	0-0
SSC FS 252-S-4	56	0	0	0	0-0
EB 137-1-2-S-3	53	0	<1	<1	0-1
EB 229-4-1-S-6-1	52	<1	<1	<1	0-1
EBS 137-2-S-1-DM-1	71	<1	<1	<1	0-1
NEP S88-5690-S-8-4	59	<1	0	<1	0-1
J 797-1-S-3	50	0	<1	<1	0-2
700130-S-1-DM-1	69	<1	<1	<1	0-2
EB 132-2-S-5-2-DM-1	53	<1	0	<1	0-2
EB 218-1-S-2	57	<1	<1	<1	0-2
EBS 46-1-2-S-2	57	<1	<1	<1	0-2
EB 112-1-S-1-1	53	0	1	<1	0-5
P-10-S-1	50	<1	<1	<1	0-5
J 2226-S-1-1-DM-1	50	1	<1	1	0-5
WC FS 151-S-1-1	52	1	1	1	0-5
EB 15-1-S-3-1	57	1	<1	1	0-5
EB 24-1-S-5	50	<1	1	1	0-15
EB 142-1-1-S-2-1	53	1	2	1	0-20
EB 237-2-S-3	53	3	3	3	0-15
P-20-S-1	50	4	3	3	0-15
SAR 466-S-1-DM-1	50	1	6	3	0-25
EB 80-1-1-S-5	62	<1	6	3	0-35
EBS 119-2-1-S-1-1	50	5	4	4	0-25
WC FS 142-S-1-1	50	2	7	4	0-35
EB 117-4-3-S-2-2-DM-1	62	7	3	5	0-30
J 1974-S-2-3	50	8	3	5	0-45
EBS 70-1-S-4-3	53	9	4	6	0-40
IP 2789-S-2	57	7	7	7	0-30
EB 54-1-1-S-7-3	57	14	1	7	0-45
EB 209-1-6-S-7	50	1	15	8	0-50
J 2222-S-1-3	50	14	7	10	0-50
3/4 Ex-Bornu 220-S-1-DM-1	50	18	28	23	0-75
Local-Resistant (SSC FS-252-S-2-DM-1)	50	6	4	5	0-50
Local-Susceptible (ICH-105)	52	24	29	26	1-85
Trial Check (BJ-104)	53	31	29	30	5-60

a/ Mean of 40 inoculated-bagged heads in two replications and each datum is rounded off to the nearest whole number

Table 4. Smut, ergot, and downy mildew (DM) reactions, and days to 75% flowering (DTF) of the 1980 IPMSN entries during the 1980 rainy season at Jamnagar

Entry	DTF	Smut severity(%)				Ergot[b] %	DM[b] %
		Rep 1	Rep 2	Mean[a]	Range		
ICI 7517-S-1	63	0	0	0	0-0	4	0
SSC PS 252-S-4	61	0	0	0	0-0	2	0
EB 137-1-2-S-3	61	0	0	0	0-0	6	<1
EB 218-1-S-2	61	0	0	0	0-0	5	0
EB 112-1-S-1-1	49	0	0	0	0-0	5	0
NEP 588-5690-S-8-4	65	0	0	0	0-0	5	<1
J 2226-S-1-1-DM-1	61	0	<1	<1	0-1	7	0
J 1974-S-2-3	55	<1	0	<1	0-1	5	1
EB 142-1-1-S-2-1	50	<1	<1	<1	0-1	6	1
EBS 46-1-2-S-2	42	<1	0	<1	0-1	1	3
EBS 137-2-S-1-DM-1	72	<1	<1	<1	0-2	1	1
700130-S-1-DM-1	67	<1	<1	<1	0-5	4	0
EB 229-4-1-S-6-1	48	<1	1	<1	0-10	3	0
J 797-1-S-3	52	<1	1	<1	0-10	4	0
EB 132-2-S-S-2-DM-1	49	0	1	<1	0-20	2	17
P-10-S-1	52	1	1	1	0-10	3	2
EBS 119-2-1-S-1-1	55	1	1	1	0-10	4	0
EB 15-1-S-3-1	58	1	1	1	0-20	6	2
EB 237-2-S-3	52	1	1	1	0-25	3	0
EB 80-1-1-S-S	62	2	<1	1	0-25	5	<1
EB 117-4-3-S-2-2-DM-1	67	2	1	1	0-30	1	0
WC FS 151-S-1-1	61	3	2	2	0-20	5	<1
SAR 466-S-1-DM-1	63	0	4	2	0-50	3	1
IP 2789-S-2	59	2	4	3	0-25	4	9
J 2222-S-1-3	61	6	5	5	0-30	0	0
EB 209-1-6-S-7	56	9	2	5	0-75	3	0
EB 54-1-1-S-7-3	55	7	5	6	0-35	8	0
EBS 70-1-S-4-3	57	8	7	7	0-60	10	0
EB 24-1-S-5	57	8	8	8	0-50	6	0
P-20-S-1	52	21	7	14	0-90	4	2
3/4 Ex Bornu 220-S-1-DM-1	52	18	12	15	0-75	8	0
WC FS 142-S-1-1	52	24	6	15	0-90	2	1
Local - Resistant	49	27	29	28	0-90	9	0
Local - Susceptible	50	23	26	24	1-90	4	0
Trial Check (BJ-104)	47	34	28	31	1-90	2	5

a/ Mean of 40 inoculated-bagged heads in 2 replications and each datum is rounded off to the nearest whole number

b/ Mean of 2 replications

Table 5. Smut, ergot, and downy mildew (DM) reactions, and days to 75 percent flowering (DTF) of the 1980 IPMSN entries during the 1980 rainy season at ICRISAT Center

Entry	DTF	Smut Severity(%)				Ergot[b] %	DM[c] %
		Rep 1	Rep 2	Mean[a]	Range		
ICI 7517-S-1	62	0	0	0	0-0	63	0
SSC FS 252-S-4	55	0	0	0	0-0	28	0
EB 112-1-S-1-1	49	0	0	0	0-0	43	0
EB 15-1-S-3-1	58	<1	0	<1	0-1	33	0
NEP 588-5690-S-8-4	58	0	<1	<1	0-2	37	1
IP 2789-S-2	52	<1	<1	<1	0-2	33	20
SAR 466-S-1-DM-1	53	<1	<1	<1	0-2	56	4
EB 117-4-3-S-2-2-DM-1	58	<1	<1	<1	0-2	1	0
EBS 137-2-S-1-DM-1	60	<1	<1	<1	0-1	10	36
EB 132-2-S-5-2-DM-1	52	<1	<1	<1	0-5	44	7
EB 237-2-S-3	50	<1	<1	<1	0-2	38	2
J 2222-S-1-3	57	<1	<1	<1	0-2	14	0
WC FS 151-S-1-1	53	1	1	1	0-5	51	0
EBS 119-2-1-S-1-1	50	<1	1	1	0-10	66	1
700130-S-1-DM-1	56	1	<1	1	0-5	27	5
J 1974-S-2-3	52	1	<1	1	0-10	51	3
EB 24-1-S-5	53	<1	1	1	0-10	49	2
EB 218-1-S-2	56	2	0	1	0-35	53	0
EB 137-1-2-S-3	51	<1	2	1	0-40	54	0
EB 80-1-1-S-5	59	2	<1	1	0-35	24	1
J 2226-S-1-1-DM-1	51	<1	4	2	0-70	63	0
EB 142-1-1-S-2-1	54	<1	4	2	0-40	60	2
EB 209-1-6-S-7	51	2	2	2	0-50	38	2
EB 229-4-1-S-6-1	53	1	4	2	0-70	68	2
EBS 70-1-S-4-3	55	3	3	3	0-35	61	2
WC-FS 142-S-1-1	54	2	5	3	0-30	67	5
EB 54-1-1-S-7-3	52	3	4	3	0-50	33	0
J 797-1-S-3	50	1	6	4	0-60	59	1
EBS 46-1-2-S-2	50	4	4	4	0-80	49	2
P-10-S-1	50	12	7	9	0-90	55	1
3/4 Ex Bornu 220-S-1-DM-1	50	27	49	38	2-95	75	0
Local - Resistant (SSC FS-252-S-2-DM-4)	51	<1	<1	1	0-40	57	-
Local - Susceptible(ICH-105)	50	30	85	57	1-98	85	-
Trial Check (BJ-104)	44	59	63	61	1-98	86	40

a/ Mean of 40 inoculated-bagged heads in two replications [illegible] is rounded off to the nearest whole number

b/ Mean of 40 bagged-inoculated-bagged heads in two replications

c/ Mean of 2 replications

Table 6. Smut reactions and days to 75 percent flowering (DTF) of the 1980 IPMSN entries during the 1980 rainy season at Bambey

Entry	DTF	Smut Severity(%)			
		Rep 1	Rep 2	Mean[a]	Range
SSC FS 252-S-4	66	0	0	0	0-0
NEP S88-5690-S-8-4	57	0	<1	<1	0-2
EB 132-2-S-5-2-DM-1	52	<1	<1	<1	0-2
EBS 137-2-S-1-DM-1	64	0	1	<1	0-5
EB 112-1-S-1-1	53	<1	<1	<1	0-5
SAR 466-S-1-DM-1	57	1	<1	<1	0-5
EB 15-1-S-3-1	62	1	0	<1	0-10
ICI 7517-S-1	67	2	0	1	0-5
J 2226-S-1-1-DM-1	56	1	1	1	0-5
EB 137-1-2-S-3	62	1	1	1	0-5
EB 218-1-S-2	56	1	1	1	0-5
EBS 46-1-2-S-2	53	<1	2	1	0-10
EBS 119-2-1-S-1-1	55	1	1	1	0-10
J 1974-S-2-3	52	1	1	1	0-15
WC FS 151-S-1-1	56	1	1	1	0-10
700130-S-1-DM-1	65	2	1	1	0-15
IP 2789-S-2	53	2	3	2	0-15
EB 117-4-3-S-2-2-DM-1	65	1	4	2	0-20
EB 24-1-S-5	60	3	1	2	0-20
P-10-S-1	53	5	2	3	0-20
EB 80-1-1-S-5	55	4	2	3	0-35
J 797-1-S-3	52	8	1	4	0-65
J 2222-S-1-3	56	5	6	5	0-40
EB 237-2-S-3	62	8	2	5	0-65
EB 209-1-6-S-7	63	9	4	6	0-50
P-20-S-1	52	11	2	6	0-60
EB 142-1-1-S-2-1	53	6	6	6	0-75
EB 229-4-1-S-6-1	52	15	2	8	0-40
WC FS 142-S-1-1	52	18	3	10	0-90
EBS 70-1-S-4-3	56	11	17	14	0-100
EB 54-1-1-S-7-3	49	34	25	29	0-90
3/4 Ex Bornu 220-S-1-DM-1	55	48	33	40	5-95
Local - Resistant	50	19	7	13	0-50
Local - Susceptible	53	10	8	9	0-35
Trial Check (BJ-104)	49	48	14	31	5-95

a/ Mean of 40 bagged heads in two replications and each datum is rounded off to the nearest whole number

Table 7. ... ..., ergot, downy mildew (DM), rust, and blast reactions, and days to 50% flowering (DTF) of the 1980 IPNSN entries during the 1980 rainy season at Samaru

Entry	DTF	Smut Severity (%) Rep 1	Rep 2	Mean[a]	Range	Ergot[b]	DM[b]	Rust[c]	Blast[c]
EB 117-4-3-S-2-2-DM-1	54	1	2	1	0-20	10	57	1	2
EBS 137-2-S-1-DM-1	59	2	5	3	0-10	42	9	1	2
SSC FS 252-S-4	49	4	4	4	0-10	77	43	1	1
EB 80-1-1-S-5	57	3	7	5	0-30	20	19	1	1
J 2222-S-1-3	48	2	15	8	0-60	55	56	1	1
700130-S-1-DM-1	50	4	12	8	0-60	70	29	1	1
NEP 588-5690-S-8-4	57	6	11	8	1-35	42	18	1	1
ICI 7517-S-1	59	4	16	10	0-50	75	16	1	1
IP 2789-S-2	48	4	16	10	0-70	37	56	1	1
WC FS 151-S-1-1	51	2	20	11	0-75	75	49	1	1
WC FS 142-S-1-1	48	5	17	11	0-65	67	29	1	1
EB 237-2-S-3	56	6	16	11	2-60	65	38	1	1
EB 218-1-S-2	54	11	13	12	0-60	80	27	1	1
EB 24-1-S-5	57	17	11	14	0-80	50	45	1	1
EB 112-1-S-1-1	49	17	11	14	5-70	65	62	1	1
P-20-S-1	49	10	21	15	1-75	70	36	1	1
EB 132-2-S-5-2-DM-1	41	10	21	15	1-75	62	10	1	1
EBS 119-2-S-1-1	54	7	24	15	0-60	70	71	1	1
SAR 466-S-1-DM-1	54	16	20	18	2-50	77	13	1	1
EB 209-1-6-S-7	54	17	19	18	0-100	50	18	1	1
EB 142-2-1-S-2-1	49	19	18	18	0-75	62	36	1	2
EB 15-1-S-3-1	56	26	12	19	1-75	60	58	1	1
J 797-1-S-3	48	9	32	20	1-75	42	33	1	1
EBS 46-1-2-S-2	56	21	22	21	0-75	80	82	1	2
J 2226-S-1-1-DM-1	54	9	45	27	0-70	65	34	1	1
EB 229-4-1-S-6-1	49	13	41	27	2-80	90	36	1	2
3/4 Ex Bornu 220-S-1-DM-1	48	39	19	29	0-80	60	91	1	1
EBS 70-1-S-4-3	57	43	26	34	5-95	90	24	1	2
J 1974-S-2-3	49	44	32	38	5-95	65	22	1	2
P-10-S-1	52	27	51	39	2-85	77	11	1	2
EB 54-1-1-S-7-3	49	39	39	39	0-95	47	58	1	1
EB 137-1-2-S-3	49	34	49	41	2-85	62	8	1	2
Local - Resistant	49	49	34	41	1-90	62	18	1	1
Local - Susceptible	56	27	29	28	1-85	50	28	1	2
Trial Check (BJ 104)	35	53	83	68	5-95	82	57	1	1

a/ Mean of 40 inoculated-bagged heads in 2 replications and each datum is rounded off to the nearest whole number

b/ Mean of 2 replications

c/ Mean of 2 replications scored on a 1-5 scale

Table 8. Smut, ergot, downy mildew (DM) reactions, and days to 75 percent flowering (DTF) of the 1980 IPMSN entries during the 1980 rainy season at Kano

Entry	DTF	Smut Severity(%) Rep 1	Rep 2	Mean[a]	Range	Ergot[b] %	DM[b] %
EBS 137-2-S-1-DM-1	57	2	5	3	0-10	15	57
EB 15-1-S-3-1	55	4	3	3	0-20	55	38
SSC FS 252-S-4	56	2	5	3	0-30	30	65
EB 112-1-S-1-1	54	6	2	4	0-30	45	56
SAR 466-S-1-DM-1	54	8	2	5	0-30	55	25
EBS 46-1-2-S-2	40	-	5	5	1-50	5	62
EB 218-1-S-2	54	5	9	7	0-30	30	81
EB 132-2-S-5-2-DM-1	47	9	5	7	2-25	35	83
IP 2789-S-2	47	8	6	7	0-50	25	94
EB 237-2-S-3	55	12	3	7	1-50	25	49
EB 117-4-3-S-2-2-DM-1	53	9	7	8	1-40	8	95
ICI 7517-S-1	59	7	9	8	0-70	32	22
J 2222-S-1-3	47	13	6	9	2-30	12	91
J 1974-S-2-3	48	14	8	11	1-90	30	32
EB 209-1-6-S-7	56	11	14	12	1-50	12	85
NEP 588-S690-S-8-4	57	19	6	12	1-80	25	52
700130-S-1-DM-1	50	3	23	13	0-90	45	86
EB 24-1-S-5	57	18	13	15	1-80	30	83
EBS 119-2-1-S-1-1	54	24	10	17	2-75	35	87
EBS 70-1-S-4-3	66	20	16	18	0-90	55	51
EB 80-1-1-S-5	52	34	9	21	2-80	30	22
WC FS 142-S-1-1	48	24	20	22	5-90	30	76
EB 137-1-2-S-3	52	24	26	25	2-80	30	57
P-10-S-1	49	29	26	27	2-80	35	11
EB 54-1-1-S-7-3	52	27	30	28	2-95	15	86
EB 142-1-1-S-2-1	52	26	35	30	5-90	47	70
P-20-S-1	41	41	21	31	5-80	30	40
WC FS 151-S-1-1	52	21	46	33	2-80	50	79
EB 229-4-1-S-6-1	53	30	45	37	5-90	50	31
J 797-1-S-3	47	48	38	43	5-95	45	84
3/4 Ex Bornu 220-S-1-DM-1	48	19	70	44	2-90	20	96
J 2226-S-1-1-DM-1	57	61	37	49	5-95	35	98
Local - Resistant	57	15	17	16	1-60	55	39
Local - Susceptible	51	15	16	15	2-50	35	37
Trial Check (BJ-104)	35	69	75	72	20-95	65	71

a/ Mean of 40 inoculated-bagged heads in 2 replications and each datum is rounded off to the nearest whole number

b/ Mean of 2 replications

Table 9. Mean and maximum smut severity (%)[a] of the 32 1980 IPMSN entries and the local checks at six locations with across location entry means[b] and across entry location means

Entry	Location[c]						
	Hissar	ICRISAT	Jamnagar	Bambey	Samaru	Kano	Overall
	Mean	Mean	Mean	Mean	Mean	Mean	Mean
SSC FS-252-S-4	0	0	0	0	4	3	1
EBS 137-2-S-1-DM-1	<1	<1	<1	<1	3	3	1
ICI 7517-S-1	0	0	0	1	10	8	3
NEP 588-5690-S-8-4	<1	<1	0	<1	8	12	3
EB 132-2-S-5-2-DM-1	<1	<1	<1	<1	15	7	3
EB 218-1-S-2	<1	1	0	1	12	7	3
EB 112-1-S-1-1	<1	0	0	<1	14	4	3
EB 117-4-3-S-2-2-DM-1	4	<1	1	2	1	8	3
EB 237-2-S-3	3	<1	1	5	11	7	4
EB 15-1-S-3-1	1	<1	1	<1	19	3	4
700130-S-1-DM-1	<1	1	<1	1	8	13	4
SAR 466-S-1-DM-1	3	<1	2	<1	18	5	5
IP 2789-S-2	7	<1	3	2	10	7	5
EBS 46-1-2-S-2	<1	4	<1	1	21	5	5
J 2222-S-1-3	10	<1	5	5	8	9	6
EB 80-1-1-S-5	3	1	1	3	5	21	6
EBS 119-2-1-S-1-1	4	1	1	1	15	17	6
EB 24-1-S-5	1	1	8	2	14	15	7
WC FS 151-S-1-1	1	1	2	1	11	33	8
EB 209-1-6-S-7	8	2	5	6	18	12	8
EB 142-1-1-S-2-1	1	2	<1	6	18	30	9
J 1974-S-2-3	5	1	<1	1	38	11	9
WC FS 142-S-1-1	4	3	15	10	11	22	11
P-20-S-1	3	10	14	6	15	31	12
EB 137-1-2-S-3	<1	1	0	1	41	25	12
EB 229-4-1-S-6-1	<1	3	<1	8	27	37	12
J 797-1-S-3	<1	4	<1	4	20	43	12
J 2226-S-1-1-DM-1	1	2	<1	1	27	49	13
P-10-S-1	<1	10	1	3	39	27	13
EBS 70-1-S-4-3	6	3	7	14	34	18	14
EB 54-1-1-S-7-3	7	5	6	29	39	28	19
3/4 Ex Bornu 220-S-1-DM-1	23	38	15	40	29	44	31
Location means	3	3	3	5	17	18	8
Local - Resistant	30	1	28	13	41	16	21
Local - Susceptible	26	57	24	9	28	15	26
Trial Check (BJ-104)	30	61	31	31	68	72	49
(No. entries mean ≤ 10%)	(31)	(31)	(30)	(29)	(9)	(13)	(22)

a/ Each datum is the mean of two rep. means and each rep. mean is derived from 20 inoculated-bagged heads except for Bambey where heads were just bagged

b/ Mean for test entries

c/ All figures are rounded off to the nearest whole numbers

Table 10. Differential reactions of some of the 1980 IPMSN entries at the test locations

Entry	Mean smut severity (%) at					
	Hissar	ICRISAT	Jamnagar	Bambey[a/]	Samaru	Kano
SSC FS 252-S-4	0	0	0	0	4	3
EBS 137-2-S-1-DM-1	<1	<1	<1	<1	3	3
EB 15-1-S-3-1	1	<1	<1	<1	19	3
MC FS 151-S-1-1	1	1	2	1	11	33
EB 142-1-1-S-2-1	1	2	<1	6	18	30
P-10-S-1	<1	10	1	3	39	27
3/4 EB 220-S-1-DM-1	23	38	15	40	29	44
BJ-104	30	61	31	31	68	72

a/ Direct inoculations not done

Table 11. Effect of number of rainy days during the inoculation/ bagging - observation period on smut development in the trial check BJ 104 at different locations

Locations	No. of rainy days during inoculation-observation period	Mean smut severity (%)
Hissar	0	30
Bambey	4	31
Jamnagar	5	31
ICRISAT Center	20	61
Samaru	22	68
Kano	24	72

Table 12. Smut reactions of six common IPMSN entries for 3 years across six locations in India and West Africa

Entry	Hissar			Jamnagar			Kamboinse			Bambey			Samaru			Kano			Mean		
	78	79	80	78	79	80	78	79	80	78	79	80	78	79	80	78	79	80	78	79	80
ICI 7517-S-1	0	0	0	<1	<1	0	0	0	-	1	0	1	13	-	10	34	-	8	8	<1	4
P-10-S-1	1	<1	<1	<1	0	1	0	0	-	<1	1	3	10	-	39	33	-	27	8	<1	14
SSC-PS-252-S-4	0	0	0	1	1	0	0	0	-	<1	1	0	12	-	4	9	-	3	4	<1	1
EB 209-1-6-S-7	2	1	8	1	<1	5	<1	0	-	3	4	6	46	-	18	32	-	12	14	1	10
P-20-S-1	2	2	3	<1	<1	14	0	<1	-	1	3	6	21	-	10	18	-	31	7	1	12
EB-54-1-1-S-7-3	1	2	7	1	<1	6	<1	<1	-	15	2	29	9	-	39	4	-	28	5	1	24
Susceptible check	15	25	30	4	11	31	-	67	-	17	11	31	65	-	68	87	-	72	38	28	46

- : Trial not conducted

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