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PROGRESS REPORT NO. 4

SELECTION AND DEVELOPMENT OF VIRUS RESISTANT POTATO BY USING PROTOPLAST CULTURE AND FUSION TECHNIQUE

A RESEARCH PROJECT

USAID/PSTC PROGRAM

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SUBMITTED BY

DR.PRASARTPORN SMITAMANA
PROJECT LEADER

FACULTY OF AGRICULTURE

CHIANG MAI UNIVERSITY

CHIANG MAI 50002

THAILAND

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Project Profile

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Project Leader	: Dr. Prasartporn Smitamana
Organization	: Faculty of Agriculture Chiang Mai University 50002 Chiang Mai, THAILAND.
Co-investigators	: Dr. Pajchima Smitamana Dr. Danai Boonyakiat Assoc. Prof. Kesinee Ramingwong
Researcher	: Mr. Visnu Somsab
Project consultant	: Dr. Sherret S. Chase Dr. Stephen L. Sinden
Authorized Officer	: Prof. Avudh Srisukri
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Content

1. Background/Introduction

Potato protoplast isolation, culture and plantlets regeneration have been accomplished in both various commercially grown tetraploid cultivars and the dihaploid clones (Binding and Nehls, 1977 ; Shepard and Totten, 1977 ; Butenko and Kucho, 1978 ; Grun and Chu, 1978 ; Wenzel et al., 1979 ; Schumann et al., 1980). Several different protocols, media, and culturing condition have already established for the potato mesophyll protoplasts and recently Jones et al. (1989) have successfully isloated and regenerated the plants from the storage parenchyma cells of potato tubers grown in vitro. Thus, the protoplasts system could be applied in various aspects such as genes expression, transformation and plant improvement by somatic hybridization which is firmly established in many crops.

As has been previously discussed, the homozygous dihaploid lines can contain valuable monogenic as well as polygenic characters such as disease resistance (Wenzel and Uhrig, 1981) but the combination of these superior genotypes by conventional breeding means is limited by the infertility in these lines (Hermsen and Ramana, 1981). Wenzel et al., (1979) have therefore proposed that, these required characters could be combined by protoplast fusion and the superior heterozygous tetraploid potato cultivar could be derived. Moreover the use of protoplast fusion also allows combinations of dihaploid genomes without meiotic segregation, and could overcome the problems of

infertility (Hermsen, 1984; Wenzel et al., 1984). Many tetraploid somatic hybrid of potato have been recovered successfully following protoplast fusion of two dihaploid clones and also from the protoplast fusion of dihaploid potato with the dihaploid Solanum brevidens (Austin et al., 1985 a, b ; Ehlenfeldt and Helgeson, 1986). It is therefore clearly proved that the protoplast fusion is a deserving technique in the modern potato breeding program.

In order to successfully obtain the viable fusion products (fusants) many fusion agents and methods have been used. Most of the fusants have been produced by using polyethylene glycol with the combination of high calcium concentration and pH and some with raising temperature (Melchers,et al., 1978 ; Shepard et al., 1983 ; Gleba and Hoffmann, 1978 ; Tabaeizadeh et al., 1985). Recently the electrofusion has been developed by Zimmerman and Scheurich (1981 a and b) and used in many laboratories. This technique has an advantage in term of very high efficiency of fusion could be achieved at room temperature and physiological pH values without the use of any chemical stimulators. Therefore, the chemical injuries during the fusion procedure could be totally excluded. However, one disadvantage of using the electrofusion techniques is the very high cost of the equipment so this is also a great barrier for many laboratories. Therefore the polyethylene glycol method is still used in this experiment.

2. Objective

2.1. To study the ploidy level of the anther derived plants.

2.2. To continue working on protoplast fusion.

2.3. To characterize the tubers derived from the previous planting period.

3. Materials and methods

3.1. Ploidy level of the anther derived plants.

Leaves from the in vitro grown plantlets either derived from the anther culture from the previous experiments or from the commercial grown tetraploidy plants were cut and the lower epidermis parts were subsequently peeled out in order to make the wet-mount preparation for the light microscopy investigation. Average numbers of chloroplasts from 100 guard cells were determined and used as an indicator for the ploidy level of the plants. The following cultivars were reported at this period :

Atlantic	H-3703*	Diamant
Kennebec	Lemhi	Norchip
Russet Burbank	Spunta	Russet Burbank (A)
JH 52*	JH 71*	K4*
K7*	*S. acaule*	

*diploid clones

3.2. Protoplast fusion and culture.

Protoplast isolation and purification was done as previously described in the second progress report, equal number of protoplasts from two origins (one diploid commercial cultivar and the S. acaule either Oka 7576 or Oka 3716) were mixed and centrifuge. The protoplast pellet was resuspended in a pre-fusion medium (2.5 g/l $CaCl_2$, 22 g/l KCl) with final concentration of 1.5×10^5 protoplasts/ml. Then ca. 0.5 ml of the mixture was transferred to the center of 6 cm plastic dish and let them settled to the bottom of the dish. Added the fusion medium (200 g/l PEG, 35 g/l $CaCl_2$, 4 g/l glycine adjusted to pH 10.5 with KOH) carefully to the edge of the protoplasts drop and incubated for 15 min. In order to remove the fusion medium, 4 ml of protoplasts wash solution was added to the dish and incubated for 5 min. Two ml of the medium was removed after the subsequent gently mixing the medium then another 3 ml of wash medium was added and incubate for 2 min. Mixed the suspension gently after that removed 3 ml of the solution and added 3 ml of culture medium. Finally 3 ml of the solution was pipetted out and 1 ml of culture medium was added. The plates were sealed with a strip of paraffin and incubated as previously described.

3.3. Morphology of the selected potato tubers.

Twenty-two clones of potatoes as listed and mentioned in the previous report were further investigated for their agronomic and tuber characteristics as follows :

a. Solanum tuberosum : 21 clones

Atlantic	Atzymba	BR 63.76	Bzura
China 3	CIP 800944	CIP 720088	CIP 800244
Denali	DTO 28	H - 3703*	Jetta
Kennebec	Lemhi	Monza	Norchip
P 005-16	Pirola	Russet Burbank	Spunta
V 2			

b. Solanum phureja : 1 clone

IVP -35

1.2 Characterization

The potato plants, at the age of 12 or 13 weeks, were observed and measured. Average of four plants from each clone were recorded for morphological structure. The studied characteristics were tubers, sprouts, as well as agronomic evaluation data. See appendix for the detail characters.

4. Results and discussion

The chloroplast numbers in the guard cells of the plants could easily be observed and counted without using any staining procedure. The average number of chloroplasts in the guard cell in most the commercial tetraploid clones is 15 - 16, where as Russet Burbank and Lemhi have lower number of chloroplasts than the others (12.7 $\pm$ 2.5 and 13.2 $\pm$ 1.4 respectively).

The anther derived Russet Burbank plantlets contain less chloroplasts in the guard cell than the normal commercial grown one. Compared with the other dihaploid clones (H 3703, JH52, K4 and K7), The range of chloroplast number within the guard cell is almost the same. Therefore, this clone could be identified as the diploidy clones (Table 1), which base on the number of chloroplasts in the guard cell. Moreover, the shape of the guard cell between the normal Russet Burbank and the anther derived plant are different. The anther derived Russet Burbank clones have almost round shape guard cell, as the normal Russet Burbank has oval shape guard cells.

Table 1 Average number and standard deviation of chloroplasts in the guard cell of the selected potatoes clones.

Cultivar	Avg. No. of Chloroplasts	Std.
Atlantic	16.028	2.892
Diamant	16.425	3.192
Kennebec	15.911	2.855
Lemhi	13.275	1.432
Norchip	16.200	1.900
Russet Burbank	12.704	2.528
Spunta	15.071	2.280
Russet Burbank (from anther)	9.597	1.765
H - 3703	10.325	1.902
JH52	9.125	1.187
JH71	6.925	1.058
K4	8.200	1.417
K7	7.675	1.233
S. acaule	11.135	1.651

Protoplast fusion.

The protoplasts turned to shrink shape after adding the fusion medium and from the cell clumps during the fusion procedure. The number of the protoplasts per each cell clump varied from two to many cells. But those cell clumps which derived from more than two protoplasts could not further divide when culture in the liquid medium. Moreover, some of the fusants were lost during the washing process, even though the protoplasts mixture had been set on the plate for 15 min. before starting the fusion process. The survived fusants formed the cell wall and the cytoplastmic strands in the cells could clearly observed as in the normal protoplast culture. First cell division could be observed after 5 days of culture. Microcalli (8 - 10 cells) could be observed with in 15 - 20 days after transferred to the medium. To stimulate the growth of the calli 1 ml of fresh medium was added about 10 days of culture. The calli could develop and see by the naked eyes within 30 - 45 days.

Characterization of potatoes.

Characterization of tubers, sprouts as well as agronomic evaluation data are shown in the appendix Table 1, 2 and 3 respectively. The title of each column in every table referred in the descriptor listed in the appendix.

Descriptions

Each clone was described for the important morphological characters as well as the agronomic evaluation data observed from the field.

China 3 : Tubers white - cream in color; skin partially netted; flesh cream; shape ovate with some clavate; tuber eyes 10.2, shallow and predominantly apical. Sprouts pale purple with white - green at the base. Weeks to harvest 13; weeks to tuber dormancy 10; tuber size medium, 5.48 x 6.64 cm.; without cracks, secondary growth, hollow heart, or internal necrosis, but with some degree of lenticels; uniformity medium; and commercial acceptability as table medium, processing almost high.

H 3703 : Tubers brownish in color; skin very heavily netted; flesh cream; shape elliptic with some clavate; tuber eyes 9.4, shallow and predominantly apical. Sprouts white - green with very pale purple lightly scattered throughout. Weeks to harvest 13; weeks to tuber dormancy 12; tuber size medium, 5.05 x 6.51

cm.; with some cracks, but without secondary growth, hollow heart, internal necrosis, or lenticels; uniformity medium; and commercial acceptability as table low, processing medium.

Kennebec : Tubers yellow in color; skin flaky; flesh white - cream; shape obovate with some clavate; tuber eyes 11.0, shallow and predominantly apical. Sprouts white - green in color. Weeks to harvest 13; weeks to tuber dormancy 14; tuber size medium, 4.36 x 6.64 cm.; without cracks, secondary growth, hollow heart, or internal necrosis, but with some degree of lenticels; uniformity medium; and commercial acceptability as table medium, processing high.

Lemhi : Tubers brownish with purple stippled; skin very heavily netted; flesh cream; shape obovate with few tuberosed; tuber eyes 11.8, shallow and predominantly apical. Sprouts white - green with purple lightly scattered throughout. Weeks to harvest 13; weeks to tuber dormancy 10; tuber size medium, 4.56 x 8.07 cm.; without cracks, secondary growth, hollow heart, internal necrosis, or lenticels; uniformity medium; and commercial acceptability as table low, processing almost high.

Monza : Tubers yellow with purple - red stippled; skin partially netted; flesh bright yellow; shape obovate with some tuberosed; tuber eyes 9.6, shallow and predominantly apical. Sprouts white - green with pale purple lightly scattered throughout. Weeks to harvest 13; weeks to tuber dormancy 9; tuber size medium, 4.65 x 6.07cm.; without cracks, secondary growth, internal necrosis,

or lenticels; uniformity medium; and commercial acceptability as table medium, processing almost high.

Norchip : Tubers white - cream in color; skin partially netted; flesh white ; shape round with some clavate; tuber eyes 10.2, shallow and predominantly apical. Sprouts white - green in color. Weeks to harvest 13; weeks to tuber dormancy 9; tuber size medium, 4.37 x 4.82 cm.; without cracks, secondary growth, hollow heart, or internal necrosis, but with some degree of lenticels; uniformity medium; and commercial acceptability as table medium, processing almost high.

Atlantic : Tubers brownish in color; skin totally netted; flesh white ; shape oblong with very few clavate; tuber eyes 9.0, shallow and predominantly apical. Sprouts white - green in color. Weeks to harvest 13; weeks to tuber dormancy 11; tuber size medium, 5.18 x 6.69 cm.; without cracks, secondary growth, hollow heart, internal necrosis, or lenticels; uniformity medium; and commercial acceptability as table medium, processing high.

P 005-16 : Tubers yellow in color; skin partially netted; flesh yellow; shape round with some flattened; tuber eyes 8.5, shallow and predominantly apical. Sprouts white - green with purple lightly scattered throughout. Weeks to harvest 12; weeks to tuber dormancy 12; tuber size very small, 2.17 x 2.30 cm.; without cracks, secondary growth, hollow heart, or

internal necrosis, but with some degree of lenticels; uniformity medium; and commercial acceptability as table low, processing medium.

Atzymba : Tubers white - cream in color; skin partially netted; flesh white; shape elliptic with few clavate; tuber eyes 13.4, shallow and predominantly apical. Sprouts white - green in color. Weeks to harvest 13; weeks to tuber dormancy 11; tuber size medium, 4.50 x 7.11 cm.; without cracks, secondary growth, hollow heart, internal necrosis, or lenticels; uniformity medium; and commercial acceptability as table medium, processing almost high.

BR 63.76 : Tubers yellow in color; skin partially netted; flesh yellow - cream; shape obovate with some flattened; tuber eyes 8.25, shallow and predominantly apical. Sprouts white - green with very pale purple lightly scattered throughout. Weeks to harvest 12; weeks to tuber dormancy 9; tuber size small, 3.49 x 4.24 cm.; without cracks, secondary growth, hollow heart, internal necrosis, or lenticels; uniformity almost high; and commercial acceptability as table and processing medium.

Bzura : Tubers yellow in color; skin partially netted; flesh yellow; shape elliptic with few clavate; tuber eyes 10.6, shallow and predominantly apical. Sprouts dark purple with white - green at the base. Weeks to harvest 13; weeks to tuber dormancy 13; tuber size medium, 4.39 x 7.21 cm.; without

cracks, secondary growth, hollow heart, or internal necrosis, but with some degree of lenticels; uniformity medium; and commercial acceptability as table medium, processing almost high.

Denali : Tubers white-cream in color; skin flaky; flesh yellow - cream; shape round with some flattened; tuber eyes 9.0, shallow and predominantly apical. Sprouts white - green with purple at the apex. Weeks to harvest 13; weeks to tuber dormancy 9; tuber size small, 4.71 x 6.04 cm.; without hollow heart, or internal necrosis, but with some degree of cracks, secondary growth, and lenticels; uniformity medium; and commercial acceptability as table low, processing medium.

DTO 28 : Tubers white - cream with red at eyebrows; skin totally netted; flesh yellow - cream; shape oblong with some tuberosed; tuber eyes 11.0, deep and predominantly apical. Sprouts purple with white - green at the apex. Weeks to harvest 12; weeks to tuber dormancy 6; tuber size medium, 5.14 x 6.73 cm.; without secondary growth, hollow heart, or internal necrosis, but with some degree of cracks and lenticels; uniformity medium; and commercial acceptability as table and processing very low.

Jetta : Tubers yellow - cream in color; skin totally netted; flesh yellow-cream; shape obovate with some tuberosed; tuber eyes 10.0, shallow and predominantly apical. Sprouts white - green in color. Weeks to harvest 12; weeks to tuber dormancy 6; tuber size medium, 5.01 x 6.19 cm.; without cracks, secondary

growth, hollow heart, or internal necrosis, but with some degree of lenticels; uniformity almost high; and commercial acceptability as table and processing almost high.

Pirola : Tubers white - cream in color; skin totally netted; flesh yellow - cream; shape round with some clavate; tuber eyes 10.4, deep and predominantly apical. Sprouts white - green in color. Weeks to harvest 13; weeks to tuber dormancy 12; tuber size medium, 4.99 x 6.04 cm.; without secondary growth, hollow heart, or internal necrosis, but with some degree of cracks and lenticels; uniformity medium; and commercial acceptability as table and processing low.

Spunta : Tubers yellow in color; skin partially netted; flesh yellow; shape long - oblong with some clavate; tuber eyes 11.2; shallow and predominantly apical. Sprouts white - green with purple at the apex. Weeks to harvest 13; weeks to tuber dormancy 10; tuber size medium, 3.94 x 6.93 cm.; without cracks, secondary growth, hollow heart, or internal necrosis, but with some degree of lenticels; uniformity medium; and commercial acceptability as table and processing low.

V -2 : Tubers brownish yellow in color; skin flaky; flesh yellow; shape elliptic with some flattened; tuber eyes 6.5, shallow and predominantly apical. Sprouts white - green in color. Weeks to harvest 12; weeks to tuber dormancy 7; tuber size small, 2.48 x 2.95 cm.; without cracks, secondary growth, hollow heart, internal necrosis, or lenticels; uniformity medium; and commercial acceptability as table low, processing almost high.

CIP 800944 : Tubers white - cream in color; skin flaky; flesh cream; shape elliptic with some clavate; tuber eyes 7.6, shallow and predominantly apical. Sprouts dark purple with white - green at the base. Weeks to harvest 12; weeks to tuber dormancy 8; tuber size small, 3.14 x 4.10 cm.; without cracks, secondary growth, hollow heart, internal necrosis, or lenticels; uniformity medium; and commercial acceptability as table low, processing medium.

CIP 720088 : Tubers white - cream in color; skin flaky; flesh cream; shape elliptic with very few reniform; tuber eyes 10.4, shallow and predominantly apical. Sprouts white - green with purple at the apex. Weeks to harvest 13; weeks to tuber dormancy 9; tuber size medium, 5.56 x 7.18 cm.; without cracks, secondary growth, hollow heart, or internal necrosis, but with some degree of lenticels; uniformity medium; and commercial acceptability as table and processing medium.

CIP 800244 : Tubers yellow with red splashed; skin partially netted; flesh yellow - cream; shape round with some tuberosed; tuber eyes 7.6, deep and predominantly apical. Sprouts purple with white - green at the apex. Weeks to harvest 13; weeks to tuber dormancy 8; tuber size medium, 4.49 x 5.33 cm.; without cracks, secondary growth, hollow heart, internal necrosis, or lenticels; uniformity almost high; and commercial acceptability as table very low, processing low.

Russet Burbank : Tubers brownish with purple - black stippled; skin very heavily netted; flesh cream; shape elliptic with some tuberosed; tuber eyes 14.2, shallow and predominantly apical. Sprouts pale white - green with very pale purple at the apex. Weeks to harvest 13; weeks to tuber dormancy 8; tuber size medium, 4.33 x 6.84 cm.; with some degree of cracks, but without secondary growth, hollow heart, internal necrosis, or lenticels; uniformity medium; and commercial acceptability as table medium, processing almost high.

IVP : No tuberization at the reporting period.

5. Conclusion/Remarks

The number of chloroplasts in the guard cell of the potato could be used as an indicator for the ploidy level (Wenzel and Foroughi-Wehr, 1984 ; Sing et al., (1989). From the anther derived Russet Burbank clones, some of the plants are not real diploid, therefore only the clones that have the plastid number less than 10 are kept and propagated for the protoplast fusion experiment. However, in order to confirm this assumption the direct chromosome counting from the root tip cells could be further investigated.

The protoplasts fusion using PEG as a fusion agent though could induce the protoplast fusion but could obtain only a limited number of fusants and still need to standardize. Moreover, the microdrop culture or in combination with the nurse cell would be one suitable technique to isolate the fusant from the unfused protoplasts at the earliest stage.

Morphological work of the 22 cultivated potato clones has been done. This data could be applicable in characterize the plants in the further study. The characters of tubers, sprouts, as well as agronomic evaluation data are completed in every cultivars except Solanum phureja, which does not happen to set any tuberization in the plot even though it could produce some tubers in the experimental pots. Each character will be discussed as the followings :

1. **Tuber Characters** : It is found that predominant skin color appear to be either white - cream, yellow, or brownish. Most cultivars do not show any secondary skin color but red or purple pigmentation can be seen in eyebrows, splashed, or stippled on the remaining cultivars. The skin types vary from partially to very heavily netted as well as rough (or flaky). The predominant flesh color is cream, yellow - cream, or yellow and without any secondary flesh color. The tuber shapes in most clones are elliptic with some obovate, round, ovate, oblong , or long - oblong in the others. The usual shapes are clavate, tuberosed, and flattened. The tuber eyes are with intermediate number that ranged from 6.5 - 14.2. The eyes in most clones are shallow in depth and predominantly apical distributed.

2. **Sprout Characters** : The predominant color is usually white - green and may be with some purple coloration in some cultivars. The secondary color may be absent as well as white - green or purple. If the secondary color is present, the distribution is either at the base, at the apex, or lightly scattered throughout.

3. **Agronomic Evaluation Data** : Potato plants is harvested at the age of 12 - 13 weeks and the tubers retain their dormancy period within 6 -14 weeks. The tuber sizes vary with the average of 4.39 x 5.96 cm., the minimum of 2.17 x 2.30 cm. in P 005-16, and the maximum of 5.56 x 7.18 cm. in CIP 720088. Tuber defects appear as some degree of cracks, secondary

growth,lenticels, but no hollow heart or internal necrosis exist. Tubers are usually with medium uniformity. The commercial acceptabilities either as table or processing vary from very low to high.

6. Workplan for the Next Period :

1. Continuing the anther culture experiments to obtain more dihaploid plants .
2. Further working on the protoplast fusion to get more fusants.
3. Report on the protein pattern analysis of the selected potato clones.

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Appendix

Descriptors for the cultivated potato used were listed as the followings :

DESCRIPTORS FOR THE CULTIVATED POTATO

A. TUBER CHARACTERS

A1 Predominant Tuber Skin Color

Code indicating the color which covers most of the surface of the tuber, expressed as :

1 White-cream

2 Yellow

3 Orange

4 Brownish

5 Pink

6 Red

7 Purplish-red

8 Purple

9 Dark purple-black

A2 Secondary Tuber Skin Color

Code describing a secondary color on the surface of the tuber, expressed as :

0 Absent

1 White-cream

2 Yellow

3 Orange

4 Brownish

5 Pink

6 Red

7 Purplish-red

8 Purple

9 Dark purple-black

A3 Distribution of Secondary Tuber Color

Code representing the pattern of distribution of the secondary color in the tuber, expressed as:

0 Absent

1 Eyes-when the secondary color is confined to the eyes only.

2 Eyebrows - when the secondary color is present in the eyebrows only.

3 Splashed - when the secondary color is confined to areas around the eyes.

4 Scattered - when the secondary color is distributed at random in one or more areas around the tuber.

5 Spectacled - when areas around the eyes do not show secondary color and the remainder of the tuber is pigmented.

6 Stippled - when the surface of the tuber is more or less uniformly covered with spots.

7 Other

A4 Tuber Skin Type

Code stating the type of tuber skin, expressed as :

1 Smooth

2 Rough (flaky)

3 Partially netted

4 Totally netted

5 Very heavily netted

6 Other

A5 Predominant Tuber Flesh Color

Code indicating the flesh color present in most of the tuber, expressed as :

1 White

2 Cream

3 Yellow-cream

4 Yellow

5 Red

6 Violet

7 Purple

8 Other

A6 Secondary Tuber Flesh Color

Code representing a secondary flesh color in the tuber, expressed as :

0 Absent

1 White

2 Cream

3 Yellow-cream

4 Cream

5 Red

6 Violet

7 Purple

8 Other

A7 Distribution of Secondary Tuber Flesh Color

Code stating the pattern of distribution of the secondary flesh color, expressed as :

0 Absent

1 Scattered spots

2 Scattered areas

3 Narrow vascular ring

4 Broad vascular ring

5 Vascular ring and medulla (pith)

6 All flesh except medulla (pith)

7 Other

A8 General Tuber Shape

Code describing the tuber outline, expressed as:

1 Compressed (oblate) - major axis is the shortest axis.

2 Round - an almost circular outline.

3 Ovate - an outline resembling an egg. The broadest part is within 1/3 of the distance from the stolon end.

4 Obovate - an outline which is inversely ovate and broadest within 1/3 of the distance from the apical end (rose or eye

end).

5 Elliptic - an outline showing the same breadth when measured at equal distance from both the stolon and apical ends. The outline is slightly acute at each end.

6 Oblong - an almost rectangular outline with the sides nearly parallel but the corners rounded. The length/breadth ratio should not be more than 3/2.

7 Long-oblong - an oblong outline with a length/breadth ratio closer to 2/1.

8 Elongate - a long rectangular outline with a length/breadth ratio equal to or more than 3/1.

A9 Unusual Tuber Shape

Code representing those variants of tuber shape which cannot be described under general tuber shape. It is expressed as follows :

0 Absent

1 Flattened - when the length of a tranverse section,at any point of the tuber, is more than three times longer than its breadth.

2 Clavate - resembling an elongated club, thickened at one end.

3 Reniform - shaped like a kidney.

4 Fusiform - spindle - shaped, tapering gradually at both ends.

5 Falcate - curved or shaped like a sickle or horseshoe.

6 Spiral - long and coiled.

7 Digitate - resembling a hand or a fist.

8 Concertina -shaped-resembling a concertina

9 Tuberosed - covered with few or many small lumps and tubers. It includes those shaped like a pineapple , a cluster of grapes, and raised internodes.

A10 Depth of Tuber Eyes

Code indicating the depth of the eyes in the tuber, expressed as :

1 Protuding

2 Shallow

3 Medium

4 Deep

5 Very deep

A11 Number of Eyes per Tuber

Code representing the number of eyes per tuber, expressed as :

1 Few (less than 5)

5 Intermediate

9 Many (more than 20)

A12 Distribution of Tuber Eyes

Code representing areas of distribution of eyes, expressed as :

1 Predominantly apical

2 Evenly distributed

B. SPROUT CHARACTERS

B1 Predominant Sprout Color

Code describing the color which covers most of the surface of the sprout, expressed as :

1 White-green

2 Pink

3 Red

4 Violet

5 Purple

6 Other

B2 Secondary Sprout Color

0 Absent

1 White-green

2 Pink

3 Red

4 Violet

5 Purple

6 Other

B3 Distribution of Secondary Sprout Color

Code which represents the distribution of the secondary color in the sprout, expressed as :

0 Absent

1 At the base

2 At the apex

3 Lightly scattered throughout

4 Heavily scattered throughout

C. AGRONOMIC EVALUATION DATA

C1 Weeks to Harvest

Recorded when 50% of the plants of an accession are ready for harvest, and indicated by the senescence of vines against a standard local.

3 Early

5 Medium

7 Late

C2 Weeks of Tuber Dormancy

Counted as the number of weeks from harvest date to the sprouting of tubers, and recorded in at least 50% of the tubers stored in paper bags at room temperature and when the length of the sprouts is at least 5 mm.

C3 Tuber Size

3 Small

5 Medium

7 Large

C4 Tuber Cracks

0 Absent

1 Present

C5 Tuber Secondary Growth

0 Absent

1 Present

C6 Hollow Heart

0 Absent

1 Present

C7 Internal Necrosis

0 Absent

1 Present

C8 Tuber Lenticels

0 Absent

1 Present

C9 Uniformity of Tuber

3 Low

5 Medium

7 High

C10 Commercial Acceptability as table potato

Code indicating the preference of consumer's utilization as baking, boiling, frying and French frying. The criteria of preferred cultivars based on high yield, light color of skin and flesh, high uniformity of size, shallow eyes, high specific gravity and free from diseases as well as tuber defects e.g. cracks, secondary growth, hollow heart, internal necrosis and lenticels.

3 Low

5 Medium

7 High

C11 Commercial Acceptability as Processing Potato

Code indicating the preference of consumer's

utilization as frozen French frying and dehydrating. The criteria of preferred cultivars based on high yield, white or cream in flesh color, high uniformity of shape, shallow eyes, high total solid and free from diseases as well as tuber defects, e.g. secondary growth, hollow heart, and internal necrosis.

3 low

5 medium

7 high

Descriptions

A descriptive information was organized and presented as the plant descriptions. Characters to be described are - tuber characters : predominant skin color, secondary skin color and its distribution, skin type, predominant flesh color, secondary flesh color and its distribution, general shape, unusual shape, depth of eyes, number of eyes per tuber, and the distribution ; sprout characters : predominant color, secondary color and its distribution ; agronomic evaluation data : weeks to harvest, weeks to dormancy, tuber size, cracks, secondary growth, hollow heart, internal necrosis, lenticels, uniformity of tubers, and commercial acceptability.

Table 1 Characterization of tubers

No.	Clone	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
1	China 3	1	0	0	3	2	0	0	3	2	2	4	1
2	H 3703	4	0	0	5	2	0	0	5	2	2	4	1
3	Kennebec	2	0	0	2	1	0	0	4	2	2	5	1
4	Lemhi	4	8	6	5	2	0	0	4	9	2	5	1
5	Monza	2	7	6	3	4	0	0	4	9	2	4	1
6	Norchip	1	0	0	3	1	0	0	2	2	2	4	1
7	Atlantic	4	0	0	4	1	0	0	6	2	2	4	1
8	P 005-16	2	0	0	3	4	0	0	2	1	2	3	1
9	Atzymba	1	0	0	3	1	0	0	5	2	2	6	1
10	BR 63.76	2	0	0	3	3	0	0	4	1	2	3	1
11	Bzura	2	0	0	3	4	0	0	5	2	2	4	1
12	Denali	1	0	0	2	3	0	0	2	1	2	4	1
13	DTO 28	1	6	2	4	3	0	0	6	9	4	5	1
14	Jetta	1	0	0	4	3	0	0	4	9	2	4	1
15	Pirola	1	0	0	4	3	0	0	2	2	4	4	1
16	Spunta	2	0	0	3	4	0	0	7	2	2	5	1
17	V -2	2	0	0	2	4	0	0	5	1	2	2	1
18	CIP 800944	1	0	0	2	2	0	0	5	2	2	3	1
19	CIP 720088	1	0	0	2	2	0	0	5	3	2	4	1
20	CIP 800244	2	6	3	3	3	0	0	2	9	4	3	1
21	Russet Burbank	4	9	6	5	2	0	0	5	9	2	6	1
22	IVP	-	-	-	-	-	-	-	-	-	-	-	-

Table 2 Characterization of sprouts

No.	Clone	B1	B2	B3
1	China 3 F	5	1	1
2	H 3703	1	5	3
3	Kennebec	1	0	0
4	Lemhi	1	5	3
5	Monza	1	5	3
6	Norchip	1	0	0
7	Atlantic	1	0	0
8	P 005-16	1	5	3
9	Atzymba	1	0	0
10	BR 63.76	1	5	3
11	Bzura	5	1	1
12	Denali	1	5	2
13	DTO 28	5	1	2
14	Jetta	1	0	0
15	Pirola	1	0	0
16	Spunta	1	5	2
17	V -2	1	0	0
18	CIP 800944	5	1	1
19	CIP 720088	1	5	2
20	CIP 800244	5	1	2
21	Russet Burbank	1	5	2
22	IVP	-	-	-

Table 3 Agronomic evaluation data

No.	Clone	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
1	China 3	13	10	5	0	0	0	0	0	4	3	5
2	H 3703	13	12	5	1	0	0	0	0	5	2	4
3	Kennebec	13	14	4	0	0	0	0	1	5	4	6
4	Lemhi	13	10	5	0	0	0	0	0	5	1	4
5	Monza	13	9	4	0	0	0	0	0	5	3	5
6	Norchip	13	9	4	0	0	0	0	1	4	3	5
7	Atlantic	13	11	5	0	0	0	0	0	4	3	5
8	P 05-16	12	12	2	0	0	0	0	1	5	2	4
9	Atzymba	13	11	4	0	0	0	0	0	5	3	5
10	BR 63.76	12	9	3	0	0	0	0	0	6	4	4
11	Bzura	13	13	4	0	0	0	0	1	5	4	5
12	Denali	13	9	4	0	1	0	0	1	5	2	4
13	DTO 28	12	6	5	1	0	0	0	1	5	0	0
14	Jetta	12	6	5	0	0	0	0	1	6	5	5
15	Pirola	13	12	4	1	0	0	0	0	5	1	2
16	Spunta	13	10	4	0	0	0	0	0	5	3	3
17	V -2	12	7	2	0	0	0	0	0	5	2	5
18	CIP 800944	12	8	3	0	0	0	0	0	4	2	4
19	CIP 720088	13	9	5	0	0	0	0	1	5	3	4
20	CIP 800244	13	8	4	0	0	0	0	0	6	0	2
21	Russet Burbank	13	8	4	1	0	0	0	0	4	4	5
22	IVP	-	-	-	-	-	-	-	-	-	-	-