

## Abstract

This general BBCH<sup>1</sup> scale is based on the well-known uniform coding system published by MEIER et al. (1997) and avoids major changes from this widely used phenological key. The scale represents the frame for the compilation of specific scales for numerous crops which all are published (www.bba.de). A specific code proposal for phenological development of edible Musaceae on the basis of the BBCH scale is presented. Every principal growth stage was subdivided into different growth stages with codes.

<sup>1</sup> BBCH: Biologische Bundesanstalt, Bundessortenamt and CHemical Industry.

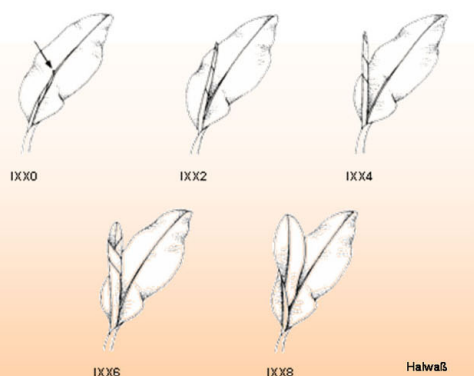
## Materials and Methods

Definitions and criteria of codification: This proposal was elaborated after perusal of the existing literature on botanical, morphological and physiological aspects of Musaceae, confirmation of the morphological codes in the field, consultation of technicians and planters with experience in banana and plantain cultivation and on the basis of previous observations and the experience of the authors.

## Results

Selected BBCH scales (complete labels: www.bba.de)

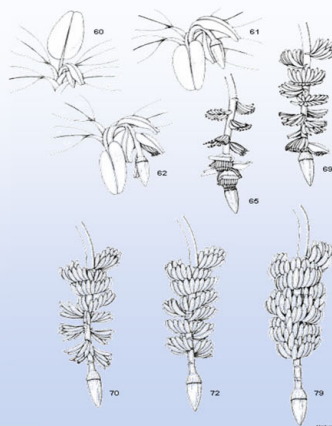
### Leaf development



Code	Description
2- 3- 4-digit	
<b>Principal stage 1: Leaf development</b>	
10 100 1000	Formation of the 1st leaf of the planted corn or the candela leaf in tissue culture plants (candela stage 0)
1002	Leaf 1 at candela stage 2
1004	Leaf 1 at candela stage 4
1006	Leaf 1 at candela stage 6
1008	Leaf 1 at candela stage 8
11 101 1010	One leaf completely open and the youngest leaf at candela stage 0
1012	One leaf completely open and the youngest leaf at candela stage 2
1014	One leaf completely open and the youngest leaf at candela stage 4
1016	One leaf completely open and the youngest leaf at candela stage 6
1018	One leaf completely open and the youngest leaf at candela stage 8
12 102 1020	Two leaves completely open and the youngest leaf at candela stage 0
1022	Two leaves completely open and the youngest leaf at candela stage 2
1024	Two leaves completely open and the youngest leaf at candela stage 4
1026	Two leaves completely open and the youngest leaf at candela stage 6
1028	Two leaves completely open and the youngest leaf at candela stage 8

Code	Description
2- 3- 4-digit	
13 103 1030	Three leaves completely open and the youngest leaf at candela stage 0
1032	Three leaves completely open and the youngest leaf at candela stage 2
1034	Three leaves completely open and the youngest leaf at candela stage 4
1036	Three leaves completely open and the youngest leaf at candela stage 6
1038	Three leaves completely open and the youngest leaf at candela stage 8 stages continue till...
19 109 1090	9 or more leaves (only 2 digit code) or nine leaves completely open and the youngest leaf at candela stage 0
1092	Nine leaves completely open and the youngest leaf at candela stage 2
1094	Nine leaves completely open and the youngest leaf at candela stage 4
1096	Nine leaves completely open and the youngest leaf at candela stage 6
1098	Nine leaves completely open and the youngest leaf at candela stage 8 stages continue till...
119 1190	Nineteen or more leaves completely open and the youngest leaf at candela stage 0
1192	Nineteen or more leaves completely open and the youngest leaf at candela stage 2
1194	Nineteen or more leaves completely open and the youngest leaf at candela stage 4
1196	Nineteen or more leaves completely open and the youngest leaf at candela stage 6
1198	Nineteen or more leaves completely open and the youngest leaf at candela stage 8

### Flowering and Development of the fruit



Code	Description
2- 3- 4-digit	
<b>Principal stage 6: Flowering</b>	
60 600 6000	The stage begins with the emergence of the flower protected by the last bract leaf (1st sterile bract)
61 601 6010	A bract which does not protect any hand of flowers rises (2nd sterile bract) and the rachis or flower stalk takes a pendulum position
62 602 6020	The bract rises which protects the first hand of female or pistillate flowers
63 603 6030	The bract rises which protects the second hand of female or pistillate flowers
64 604 6040	The bract rises which protects the third hand of female or pistillate flowers
65 605 6050	Full bloom: at least 50 % of the hands of females flowers are developed
69 609 6090	The bracts which protect the hands wither and fall off and the fingers are bent into a direction perpendicular to the rachis

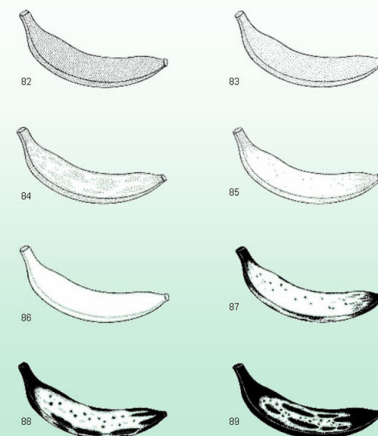
Code	Description
2- 3- 4-digit	
<b>Principal stage 7: Development of the fruit</b>	
70 700 7000	At least 50 % of the fingers show an upwards curvature and the fruits (fingers) begin to fill
71 701 7010	Total exposure of the fingers or female flowers (protective bracts fallen off or bent and withered above the hands)
72 702 7020	The fingers of the hands show the characteristic curvature of the fruit (upwards and almost parallel to the axis or rachis)
73 703 7030	From the first two hands up to 30 % of the hands have reached the maximum thickness of the fruit
74 704 7040	Up to 40 % of the hands have reached the maximum thickness of the fruit
75 705 7050	Up to 50 % of the hands have reached the maximum thickness of the fruit
76 706 7060	Up to 60 % of the hands have reached the maximum thickness of the fruit
77 707 7070	Up to 70 % of the hands have reached the maximum thickness of the fruit
78 708 7080	Up to 80 % of the hands have reached the maximum thickness of the fruit
79 709 7090	All hands have reached the maximum thickness of the fruit and no hand shows a loss of weight

### Principal growth stages of edible Musaceae

Code	Description
0	sprouting
1	leaf development
2	sucker formation
3	pseudostem elongation
4	sucker leaf development
5	inflorescence emergence
6	flowering
7	fruit development
8	fruit ripening
9	senescence

Code	Description
2- 3- 4-digit	
<b>Principal stage 8: Ripening of the fruit</b>	
80 800 8000	Ripening starts when the fruit has reached the maximum thickness, begins to lose weight and shows changes of the colour by which the degrees of maturity are defined
81 801 8010	Degree of maturity 1: green. Normal colour of the fresh fruit
82 802 8020	Degree of maturity 2: tinge of yellow. First modification of colour during the ripening cycle
83 803 8030	Degree of maturity 3: more green than yellow
84 804 8040	Degree of maturity 4: more yellow than green
85 805 8050	Degree of maturity 5: tinge of green
86 806 8060	Degree of maturity 6: all yellow
87 807 8070	Degree of maturity 7: yellow with brown specks. Fruit is completely ripe, has the best flavour and a high nutritive value
88 808 8080	Degree of maturity 8: 20-50 % of surface discoloured brown or spoiled
89 809 8090	Degree of maturity 9: More than 50 % of the surface of the fruits is discoloured brown and spoiled

### Ripening of the fruit



## References

Meier, Bleiholder, Buhr, Feller, Hack, Hess, Klose, Stauss, van den Boom, Lancashire, Weber, 1997: BBCH-Monograph. Growth stages of plants - Entwicklungsstadien von Pflanzen - Estadios de las plantas - Développement des plantes. Blackwell Wissenschaftsverlag, Berlin und Wien. p. 622